BLACK & VEATCH

8400 Ward Parkway, P.O. Box No. 8405, Kansas City, Missouri 64114, (913) 339-2000
FAX NUMBERS: 913-339-2934 913-339-2936 913-339-2939

FACSIMILE TRANSMISSION

TO: JON CHRISTENSON
COMPANY: IPSC
FAX NUMBER: 801-864-4970
TELEPHONE NUMBER: 801-864-4414
FROM: S.E. RUS
EXTENSION: 2042 LOCATION: P402
NUMBER OF PAGES, INCLUDING THIS COVER SHEET: 3
SUBJECT: P.A. FAN RELAY SETTINGS

B&V PROJECT: 15119
B&V PHASE: 906
B&V FILE:
DATE: 5/14/92

MESSAGE: Enclosed is a copy of the P.A. Fan relay settings. The high speed trip setting is unchanged. We recommend that it be set to 4.5 amp tap (time pickup) and 8.9 x tap for the instantaneous unit, provided the fan is not started on high speed. This will provide slightly more protection for the fan and switch. The trip timer will begin to pickup at 437 to 450 amperes. The present setting is at 500 amperes and which appears to be necessary to ensure a high speed start. The alarm relay (50-2) for high speed use is set at 400 amperes which is the switch rating and is lower than the fan motor service factor rating of 380 x 1.15 = 437 amperes. Normally the alarm would be 437 to 450 amperes.

Please review the settings and advise us of any comments.

cc:

DATE OF TRANSMITTAL:
TIME OF TRANSMITTAL:
OPERATOR'S INITIALS:

NOTE TO RECEIVING OPERATOR: In the event transmission is not complete, please call (913) 339-7218.

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF
RELAY SETTINGS FOR
Intermountain Power Project
IGS Unit 1
6,900-Volt Unit Switchgear 1B2

SHEET NO. 32
MADE BY DJS
CKD. BY DKU
DATE 06/12/87
Revised 5-5-92
By WKC

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME DIAL	
6	Device 87M, 1SGB-MFAN-1B Phase Current Differential Relay, Instantaneous ITE 50H 238T0545 CT Ratio: 50/5 0.8-8 ampere pickup Reference: IB 18.2.7-5E			✓ 2 x rati
7	Device 50-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	4.1 x ra 328 amp primary
7	Device 50/51-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	7	2400 4.8 x ta
7	Device 50-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	5.5 x RATING 440 AMP PRIMARY 5 x rat: 400 amp primary
7	Device 50/51-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF RELAY SETTINGS FOR
Intermountain Power Project
IGS Unit 1
6,900-Volt Unit Switchgear 1A2

SHEET NO. 13
MADE BY DJS
CKD. BY DEU
DATE 06/12/87
Revised 5-5-92
By WKC

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME DIAL	
7	Device 50-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	328 4.1 x ra 328 amp primary
7	Device 50/51-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	7	2400 4.8 x ta
7	Device 50-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	5.5 5 x rat 400 amp primary 440 AMP
7	Device 50/51-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap
7	Device 50G, 1SGB-FAN-2A Ground Overcurrent Relay, Instantaneous ITE GR5 202D6141UL 5-50 ampere pickup Reference: IB 18.1.7-2 Issue H		2 cycles	5.0 amp

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF
RELAY SETTINGS FOR
Intermountain Power Project

IGS Unit 1

6,900-Volt Unit Switchgear 1B2

SHEET NO. 32
MADE BY DJS
CKD. BY DEU
DATE 06/12/87

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME DIAL	
6	Device 87M, 1SGB-MFAN-1B Phase Current Differential Relay, Instantaneous ITE 50H 238T0545 CT Ratio: 50/5 0.8-8 ampere pickup Reference: IB 18.2.7-5E			2 x rating
7	Device 50-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	3 x rating
7	Device 50/51-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	4.0 amp	7	2400 A 6 x tap
7	Device 50-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	4 x rating
7	Device 50/51-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap

P-EL-126-A

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF
RELAY SETTINGS FOR
Intermountain Power Project

IGS Unit 1

6,900-Volt Unit Switchgear 1A2

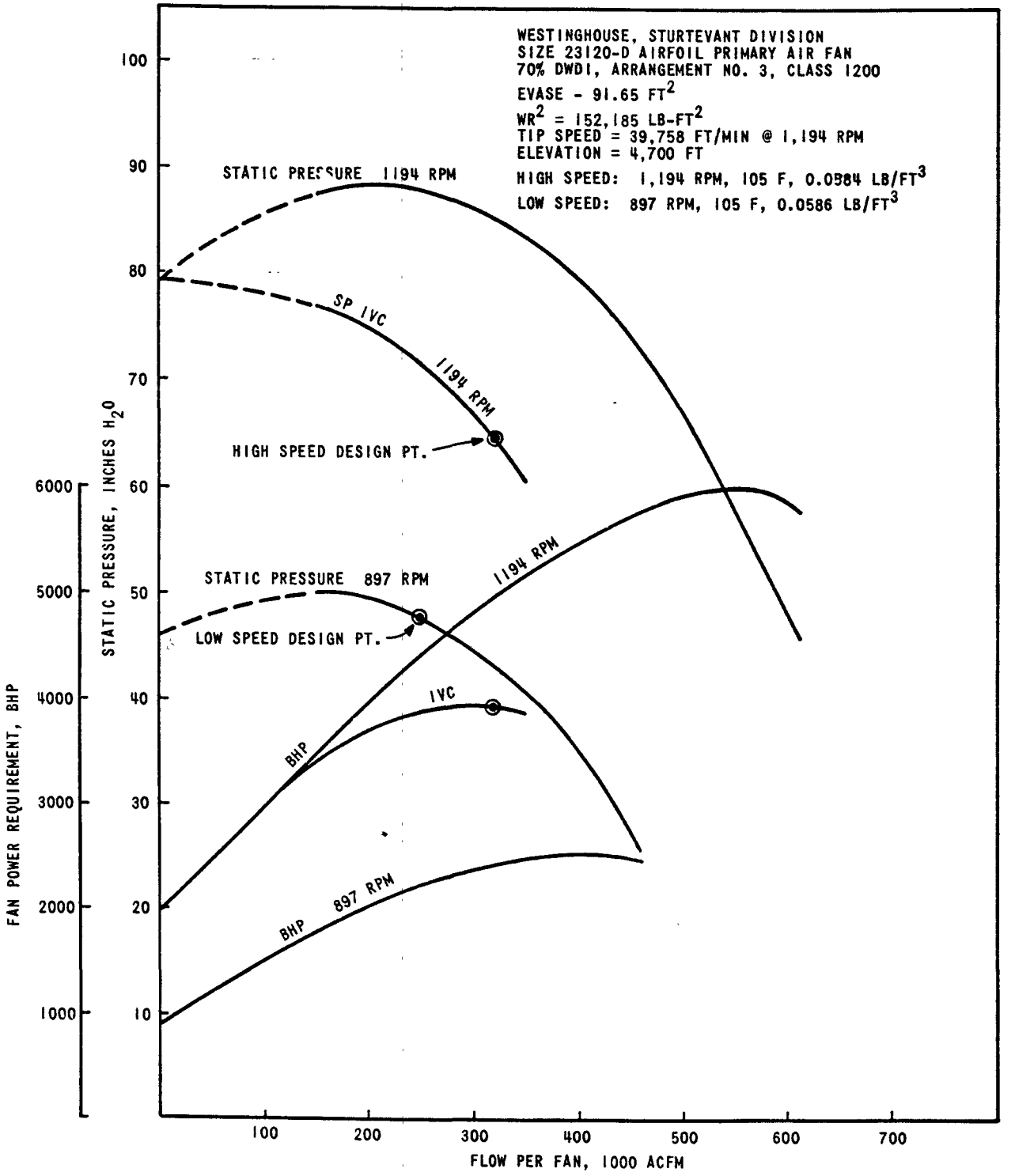
SHEET NO. 13
MADE BY DJS
CKD. BY DEU
DATE 06/12/87

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME DIAL	
7	Device 50-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	240 A 3 x rating
7	Device 50/51-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	4.0 amp	7	2400 A 6 x tap
7	Device 50-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	320 A 4 x rating
7	Device 50/51-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap
7	Device 50G, 1SGB-FAN-2A Ground Overcurrent Relay, Instantaneous ITE GR5 202D6141UL 5-50 ampere pickup Reference: IB 18.1.7-2 Issue H		2 cycles	5.0 amp

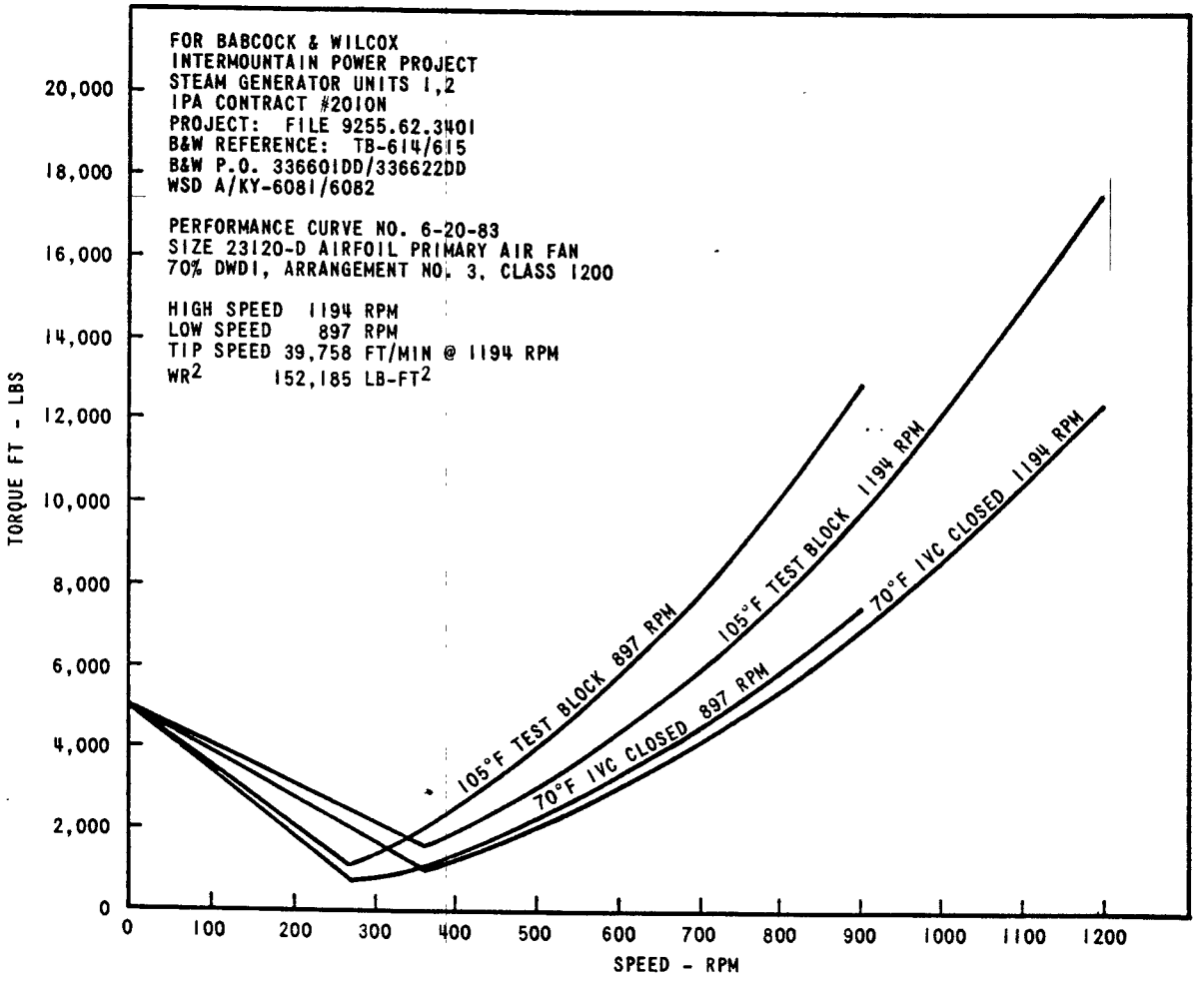
P-EL-126-A

TABLE 3-2. PRIMARY AIR FAN PREDICTED PERFORMANCE

Item	Test Block	MCR
Inlet Air Temperature, F	105	105
Inlet Air Density, lb/ft^3	0.0588	0.0588
Capacity, each fan		
Pounds per hour	1,120,300	882,000
Actual cfm	317,500	250,000
Fan Static Pressure, in. wg	62.5	44.5
Fan Static Efficiency, per cent	81.9	84.9
Design Fan Speed, rpm	1,194	897
Input Horsepower	3,810	2,061

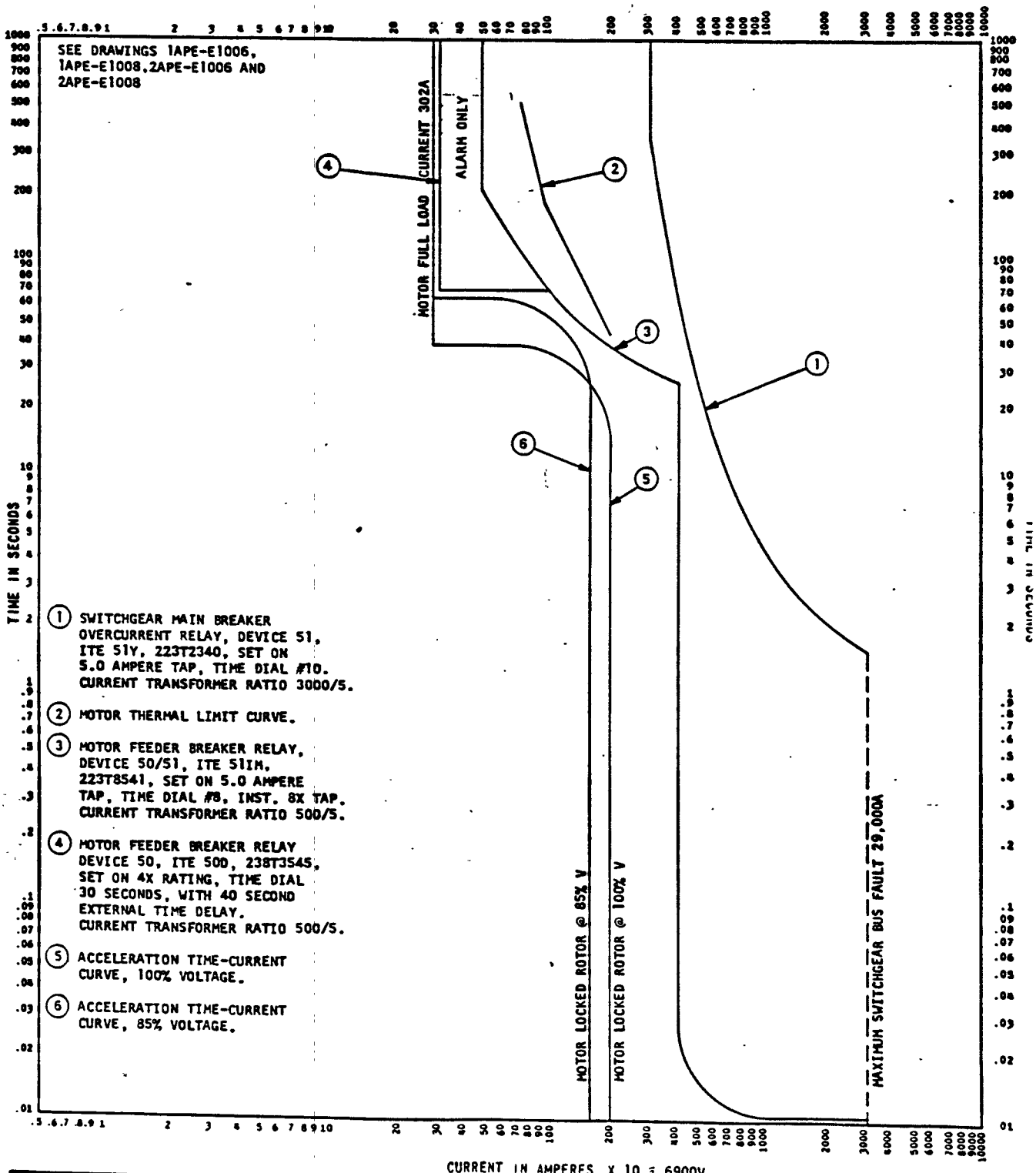


PRIMARY AIR FAN STATIC PRESSURE AND HORSEPOWER PERFORMANCE CURVES
FIGURE 3-6



PRIMARY AIR FAN
SPEED-TORQUE CURVES
FIGURE 3-7

CURRENT IN AMPERES X 10 @ 6900V



CURRENT IN AMPERES X 10 @ 6900V

NO	DATE	REVISION	DWN	CK	ACC	APP
1	6-12-87	CONFORMED TO CONSTRUCTION RECORDS	DE		LWS	
0	9-07-84	INITIAL ISSUE	DS		LWS	

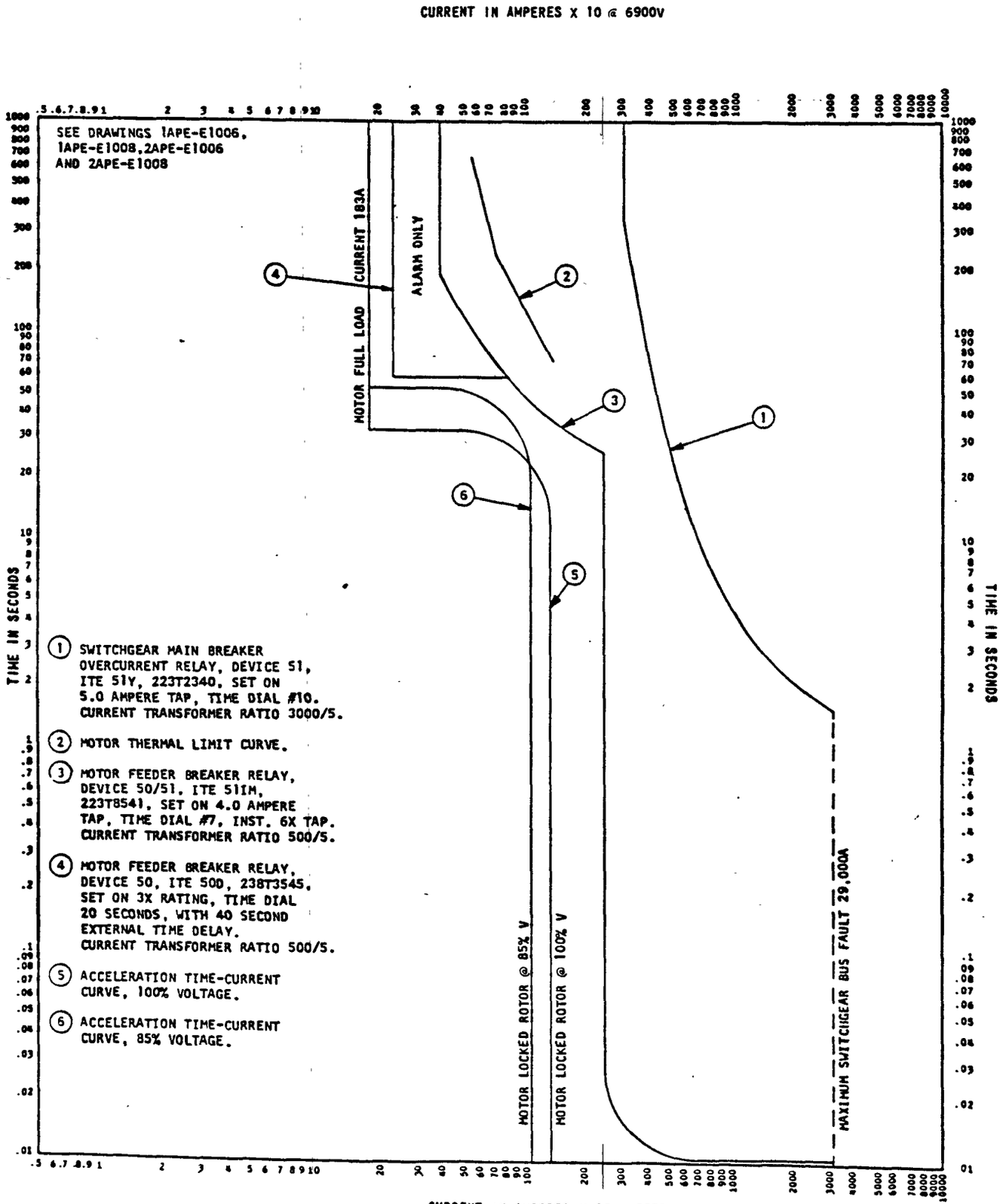
BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 9255

IPP INTERMOUNTAIN POWER PROJECT

6900 VOLT UNIT SWITCHGEAR
PRIMARY AIR FAN MOTOR
HIGH SPEED

FIG. 4-16

P-EL-076C



NO	DATE	REVISION	DWN	CK	ACC	APP
1	6-12-87	CONFORMED TO CONSTRUCTION RECORDS	DE		LWS	
0	9-07-84	INITIAL ISSUE	DS		LWS	

BLACK & VEATCH CONSULTING ENGINEERS
PROJECT 9255

IPP INTERMOUNTAIN POWER PROJECT

6900 VOLT UNIT SWITCHGEAR
PRIMARY AIR FAN MOTOR
LOW SPEED

FIG. 4-17

BLACK & VEATCH

8400 Ward Parkway, P.O. Box No. 8405, Kansas City, Missouri 64114, (913) 339-2000

Intermountain Power Service Corporation
Intermountain Generating Station

B&V Project 15119.802
B&V File 62.3401
May 7, 1991

Intermountain Power Service Corporation
Route 1, Box 864
Delta, Utah 84624

Subject: Primary Air Fans

Attention: Mr. Jerry Hintze

Gentlemen:

Per your request during the February 19, 1991 Generation Block Work Group meeting, we have reviewed the history and the sizing criteria for the Intermountain Unit 1 and 2 Primary Air Fans (PA Fans). The following comments are offered for your consideration.

1. The Steam Generator specification prepared by the Los Angeles Department of Water and Power (LADWP) included the following sizing criteria for the PA Fans.

> "With one Primary air fan out of service the remaining fans shall be capable of providing sufficient primary air to permit boiler operation up to not less than 60 percent of Maximum Capability with each of the specified coals. Test block performance of each fan with inlet boxes and silencers shall be greater than its expected operating performance by not less than 25 percent for weight flow, not less than 50 percent for static discharge pressure, and not less than 25F for temperature at the plant's elevation for each of the specified coals."

The motor sizing requirements from the Steam Generator specification were as follows.

> "The motor horsepower rating shall equal or exceed the maximum brake horsepower required by the driven equipment when the driven equipment is operating at the

design load condition. Service factor shall not be utilized to meet this requirement.

The motor horsepower rating shall meet the maximum requirement of the driven equipment without exceeding insulation temperature rating at the service conditions. Service factor may be used to meet this requirement."

2. The initial fans offered by Babcock & Wilcox were single speed Westinghouse Model 23113-A fans with inlet vane control. These fans had 113" diameter wheels and had an 1190 rpm test block rating of 318,000 cfm at 61.1 in. water static pressure and 3374 brake horsepower. At MCR conditions, the PA Fan horsepower was expected to be approximately 2,350 bhp per fan. (2 FAN OPERATION ?)

In 1981, it was decided to purchase two-speed fans to reduce fan power requirements. In August, 1981, B&W submitted its proposal for two speed PA Fans. The proposed two speed PA Fans were rated for the following condition at the lower speed.

Flow per fan	251,000 acfm
Fan static pressure	44.3 in. w.g.
Inlet density	0.059 lb/ft^3

The above condition was agreed upon by B&V and LADWP and was developed by adding 10 percent to the flow and 5 percent o the static pressure require for operation at MCR. The intent was to ensure that the fans meet all expected normal operating conditions while operating at the low speed.

The fans, as shipped, were Westinghouse Model 231200 fans with two-speed motors and inlet vane control. These fans had 127.2 inch diameter wheels and had an 1194 rpm test block rating of 320,000 cfm at 64.44 in. water static pressure rise and 3,989 brake horsepower. At the low speed, 897 rpm, the test block rating is 252,600 cfm at 47.58 in. water static pressure rise and 2,217 brake horsepower. At MCR conditions the PA Fan horsepower was expected to be approximately 1,739 bhp per fan.

The motors furnished with the PA Fans are two speed, Pole Amplitude Modulation (PAM), 6,600 volt motors manufactured by Westinghouse and are rated at 4,000 horsepower at 1, 194 rpm and 2,100 horsepower at 897 rpm.

3. The expected performance of the PA Fans is shown on the attached curve. As indicated on the attachment, there are two horsepower curves for each fan speed, one for inlet vane control and one for inlet vanes wide open. The inlet vane control horsepower curve assumes that the fans are operating along the design static pressure flow curve for boiler operation. If flow requirements are increased above the normal requirement by excessive air heater leakage, for example, the horsepower requirements will exceed the inlet vane control horsepower curve shown.

   As indicated on the attached curve, the low speed test block horsepower exceeds the motor rating of 2,100 horsepower. At high speed, the PA Fan static pressure curve greatly exceeds the test block requirements. The test block rating is achieved by throttling the inlet vanes. With the inlet vanes 100 percent open, the fan power requirements at test block flow would be 4,700 horsepower, well above the motor rating.

If we can be of any further assistance to you in studying the performance of the primary air fans, please contact Steve Rus (913-339-2042), Jay Kauphusman (913-339-2869), or me.

Very truly yours,

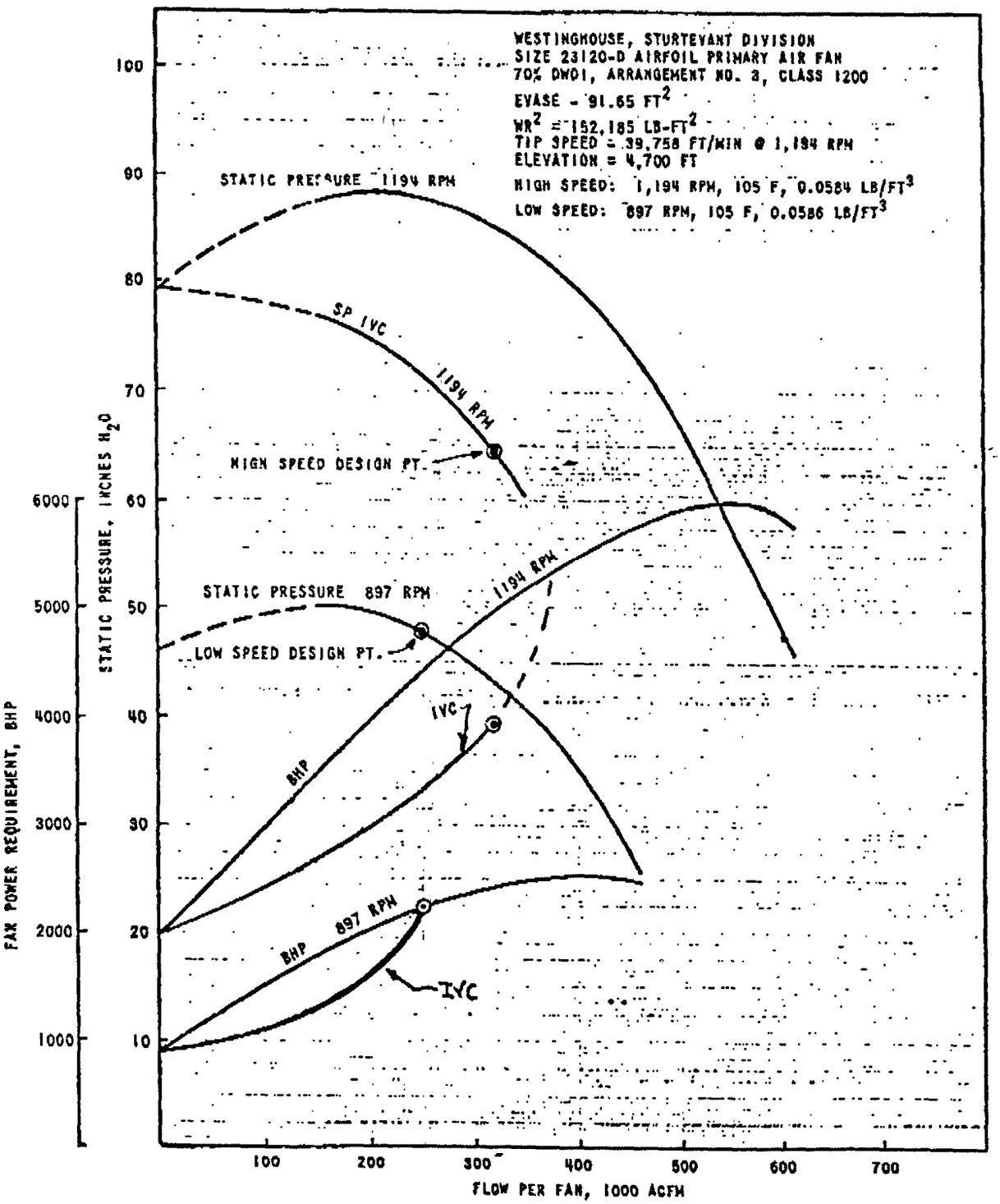
BLACK & VEATCH

P. F. Bannister

JRK:rah

cc: R.E. Gentner
M. Perez
S.G. Chapman
B.E. Blowey

bcc: P. F. Bannister
R. W. Dutton
J. R. Kauphusman
S. E. Rus


WESTINGHOUSE, STURTEVANT DIVISION
SIZE 23120-D AIRFOIL PRIMARY AIR FAN
70% DWDI, ARRANGEMENT NO. 3, CLASS 1200
EVASE - 91.65 FT²
WR² = 152,185 LB-FT²
TIP SPEED = 39,758 FT/MIN @ 1,194 RPM
ELEVATION = 4,700 FT
HIGH SPEED: 1,194 RPM, 105 F, 0.0584 LB/FT³
LOW SPEED: 897 RPM, 105 F, 0.0586 LB/FT³
STATIC PRESSURE 1194 RPM
SP IVC
1194 RPM
HIGH SPEED DESIGN PT.
STATIC PRESSURE 897 RPM
1194 RPM
LOW SPEED DESIGN PT.
IVC
BHP
BHP 897 RPM
IVC
STATIC PRESSURE, INCHES H₂O
FAN POWER REQUIREMENT, BHP
FLOW PER FAN, 1000 ACFM
100
90
80
70
60
50
40
30
20
10
6000
5000
4000
3000
2000
1000
100
200
300
400
500
600
700

BLACK & VEATCH

8400 Ward Parkway, P.O. Box No. 8405, Kansas City, Missouri 64114, (913) 339-2000

Intermountain Power Project
Intermountain Generating Station

B&V Project 15119
B&V File 806
June 2, 1992

Intermountain Power Service Corporation
1550 West Brush Wellman Road
Delta, UT 84624

Subject: Primary Air Fan Analysis

Attention: Mr. G. K. Hintze

Gentlemen:

This documents and summarizes discussions to date regarding our review of the Westinghouse Primary Air Fan Motor report dated February 26, 1992 which was transmitted by IPSC facsimile dated March 3, 1992.

The revised foundation loading included in Westinghouse's report for motor operation at 5000/3200 HP conditions does not exceed the existing foundation and anchor bolt design. The existing foundation is adequate for the indicated motor rerating.

We have reviewed the switchgear and electrical conductors based on switchgear data we have in-house and IPSC's confirmation that electrical conductors are 500 KCMIL 15 KV Type A. These components are capable of operation at the motor rerating of 5000/3200 HP. The ESCO transfer switch has a maximum listed capability of 400 amps, which is less than that required for rerated motor operation. However, IPSC has obtained confirmation from the manufacturer that the noted transfer switch is capable of operation continuously at 440 amps (attached facsimile). On this basis, the electrical components supplying the power to the Primary Air Fan motors are capable of continuous operation at the motor rerating of 5000/3200 HP.

We have attached copies of revised relay setting sheets 13 and 32 dated May 5, 1992 documenting the revised relay settings to reflect the motor rerating. The revised relay setting data sheets include marked up data to reflect continuous operation of the transfer switch at 440 amps.

If you have any questions regarding this information, please contact Steve Rus at (913) 339-2042.

Very truly yours,

BLACK & VEATCH

FOR

Paul F. Bannister

SER:skb
Enclosure

cc: Mr. J. Nelson w/enclosure
Mr. J. Chistensen w/enclosure
Mr. B. E. Blowey w/enclosure

6481

FAX TRANSMITTAL

TO: John Christensen

COMPANY: Intermountain Power Co.

FAX# 801-864-4970

FROM: Wes Colbert

COMPANY: POWELL-ESCO COMPANY
P.O. BOX 1039
GREENVILLE, TX 75403
PHONE# 903-455-6234
DALLAS: 214-442-7641

FAX# 903-455-3807

SUBJECT: 400 Amp 5 Speed Changer Switch

DATE: 5-15-92

NO OF PAGES: 1

John The 400 Amp RATED SWITCH WILL operate AT 440 Amps Continious Load WITH NO effect ON The Unit.

Wes Colbert

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF
RELAY SETTINGS FOR
Intermountain Power Project
IGS Unit 1
6,900-Volt Unit Switchgear 1A2

SHEET NO. 13
MADE BY DJS
CKD. BY DEU
DATE 06/12/87
Revised 5-5-92
By WKC

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME DIAL	
7	Device 50-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	4.1 x rating 328 amp primary
7	Device 50/51-1, 1SGB-FAN-2A (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	7	4.8 x tap
7	Device 50-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	5.5 5 x rating 400 amp primary 440
7	Device 50/51-2, 1SGB-FAN-2A (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap
7	Device 50G, 1SGB-FAN-2A Ground Overcurrent Relay, Instantaneous ITE GR5 202D6141UL 5-50 ampere pickup Reference: IB 18.1.7-2 Issue H		2 cycles	5.0 amp

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

PROJ. NO. 9255

SUMMARY OF
RELAY SETTINGS FOR
Intermountain Power Project
IGS Unit 1
6,900-Volt Unit Switchgear 1B2

SHEET NO. 32
MADE BY DJS
CKD. BY DEU
DATE 06/12/87
Revised 5-5-92
By WKC

BREAKER REFERENCE NUMBER	DESCRIPTION	RELAY SETTING		
		INDUCTION		INST.
		TAP	TIME-DIAL	
6	Device 87M, 1SGB-MFAN-1B Phase Current Differential Relay, Instantaneous ITE 50H 238T0545 CT Ratio: 50/5 0.8-8 ampere pickup Reference: IB 18.2.7-5E			2 x rating
7	Device 50-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		20 sec	4.1 x rating 328 amp primary
7	Device 50/51-1, 1SGB-FAN-2B (Low Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51LM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	7	4.8 x tap
7	Device 50-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Instantaneous ITE 50D 238T3545 CT Ratio: 500/5 0.8-8 ampere pickup 1-30 second delay Reference: IB 18.2.7-5E		30 sec	5.5 (5) x rating 400 amp primary 440
7	Device 50/51-2, 1SGB-FAN-2B (High Speed) Phase Overcurrent Relay, Long Time Inverse ITE 51IM 223T8541 CT Ratio: 500/5 2.5-5 ampere pickup (time) 2-20 times tap pickup (instantaneous) Reference: IB 7.2.1.7-1 Issue A	5.0 amp	8	8 x tap

WESTINGHOUSE ELECTRIC CORPORATION
Heavy Industry Motor Division
Round Rock, Texas 78664

INDUCTION MOTOR DATA

Shop Order: 1667AA / 1668AA General O : CL30900

Customer INTERMOUNTAIN POWER / BRISCOE AND WILCOX

R

HP: 4000/2100 Voltage: 6600 Amperes: 302/183 Service Factor 1.0

Phases: 3 Hertz: 60 F.L. Speed: 1194/897 RPM

Temp. Rise: 80 °C By RESISTANCE Insulation Class: B

Frame: 800-1800 Size Locked KVA Code: F / C

Performance

Load	S. F.	1.00	0.75	0.50	0.25
% Efficiency	—	96.4/95.9	96.4/95.6	95.8/94.6	93.1/90.9
% Power Factor	—	89.5/78.0	88.2/71.9	83.3/59.9	65.5/37.7

Rated Torque: 17582/12295 lb.-ft. Starting Torque: 90/108 %

Breakdown Torque: 253/321 % Pull-Up Torque: — % @ — % Speed

Locked Rotor Current: 1945/1343 Amps 643/734 % F. L. Slip: .45/.34 %

Circuit Constants

Per Unit on 2984/1566.6 KVA Base

Transient Reactance, X'_d: 3.396/1.500 X/R: 6.06/6.55

Sub-Transient Reactance, X''_d: 0.168/.127 PAM Motors Only

Open Circuit Time Constant, T'_{do}: 2.29/1.38 Sec Switching Time Delay

Short Circuit Time Constant, T': .113/.117 Sec Low-to-High Speed: 2 Sec

Engineer: Douglas H Cochran Date: 2/6/82

Approval: _____ Revision _____ Date: _____

FORM # HIMD-297

IP12_001838

INDUCTION MOTOR STARTING CHARACTERISTICS (CALCULATED) AT 100% LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER S P BANSAL

S.O. 01667AA G.O. CL30900 C.O. 336618DH

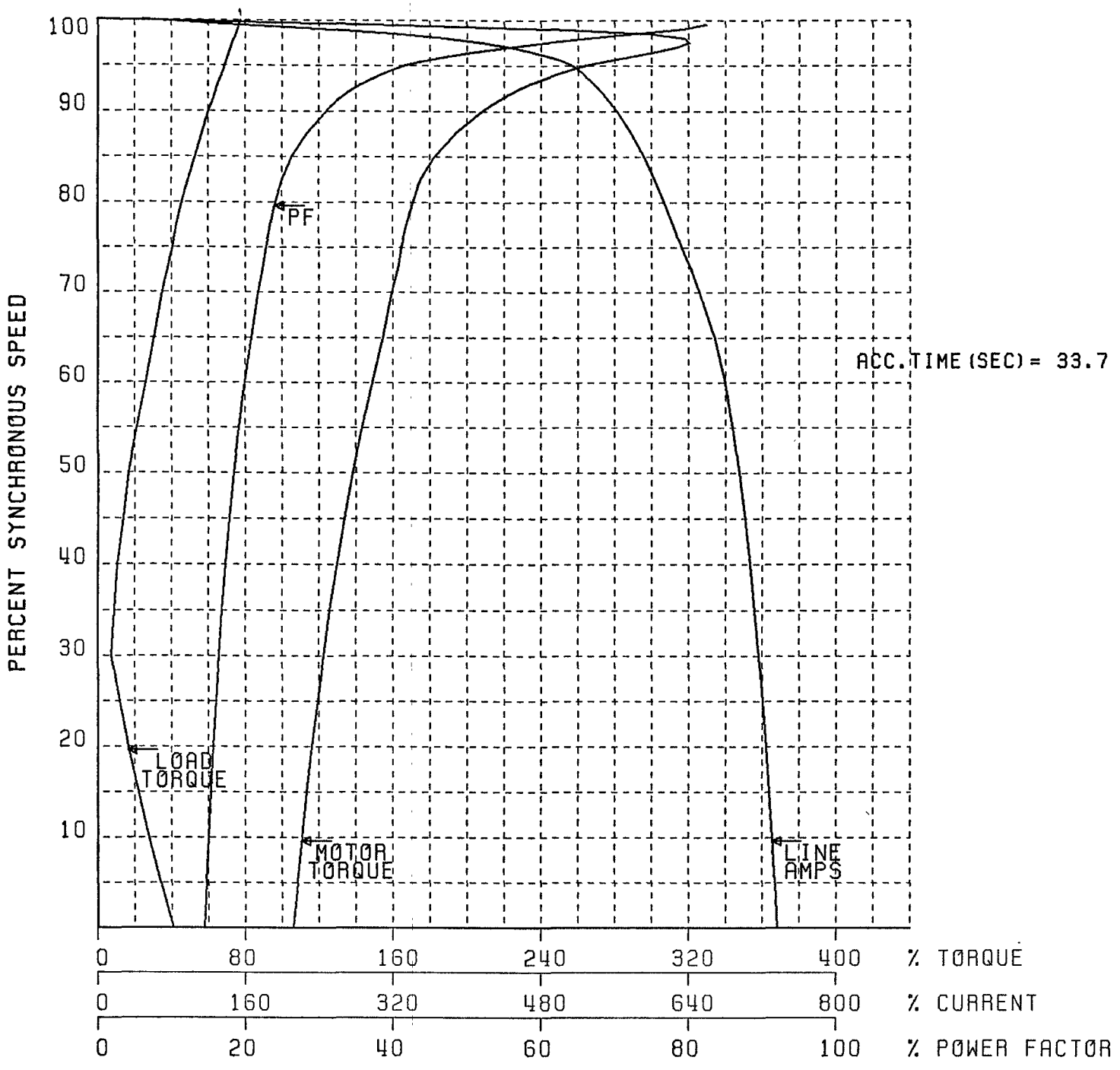
HP 2100 166BAA VOLTS 6600 PH 3 HZ 60 POLES 8 RPM (FL) 897

PF 0.78 FL AMPS 183 LOCK AMPS (%) 737 RPM (SYN) 900

FL TORQUE (LB-FT) 12295 LOCK TORQUE (%) 106

LOAD WK² (LB-FT²) 152185 MOTOR WK² (LB-FT²) 9393 FRAME 8018

LOAD CURVE 7-7-81-2 APPLICATION PRIMARY AIR FAN



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal DATE: 12/29/82 CURVE NO. DHC0182010

IP12_001839

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 85 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER S P BANSAL

S.O. 01667AA G.O. CL30900 C.O. 336618DH

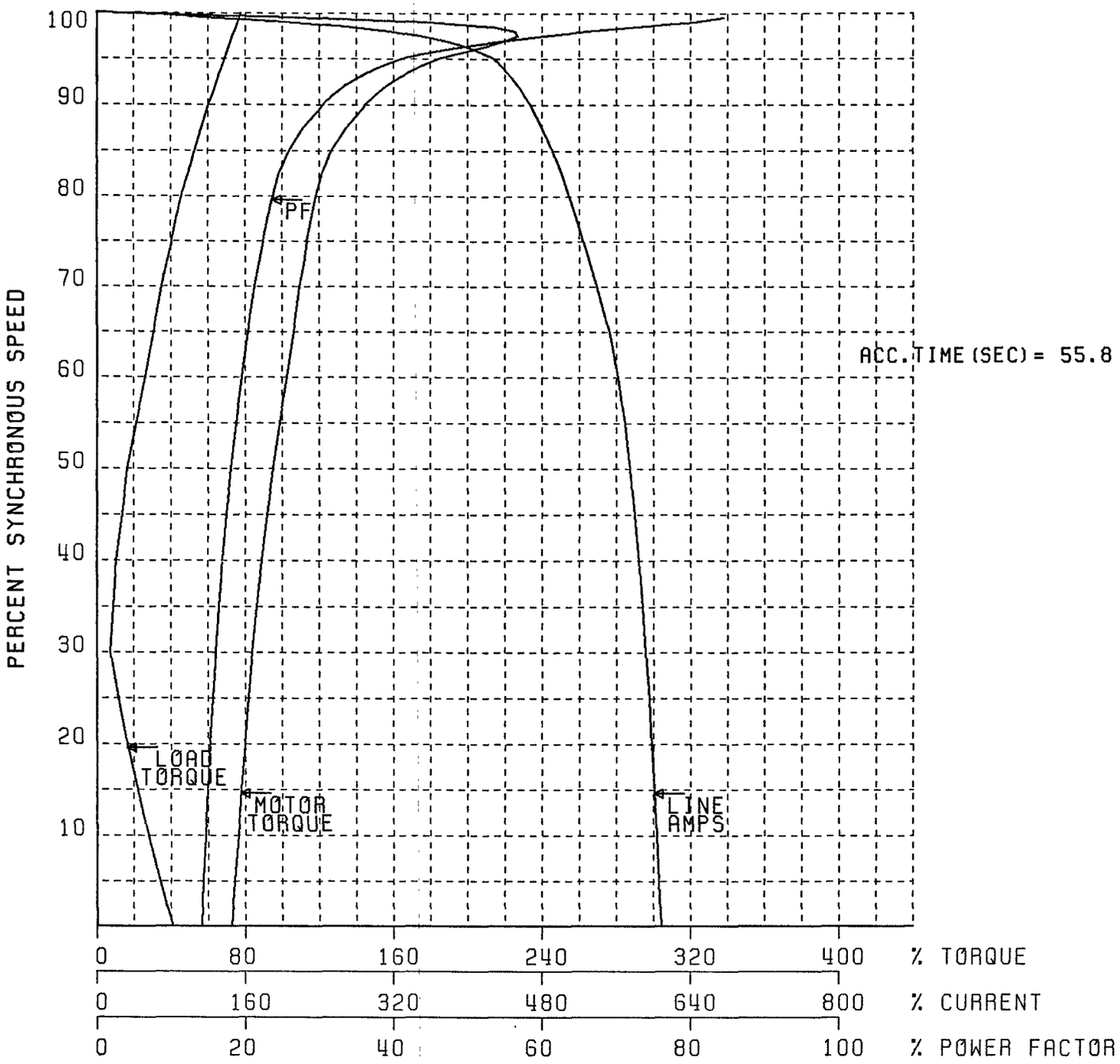
HP 2100 166BAA VOLTS 6600 PH 3 HZ 60 POLES 8 RPM (FL) 897

PF 0.78 FL AMPS 183 LOCK AMPS (%) 608 RPM (SYN) 900

FL TORQUE (LB-FT) 12295 LOCK TORQUE (%) 73

LOAD WK² (LB-FT²) 152185 MOTOR WK² (LB-FT²) 9393 FRAME 8018

LOAD CURVE 7-7-81-2 APPLICATION PRIMARY AIR FAN



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal DATE: 12/29/82 CURVE NO. DHC0182010

INDUCTION MOTOR STARTING CHARACTERISTICS (CALCULATED) AT 100% LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER S P BANSAL

S.O. 01667AA G.O. CL30900 C.O. 336618DH

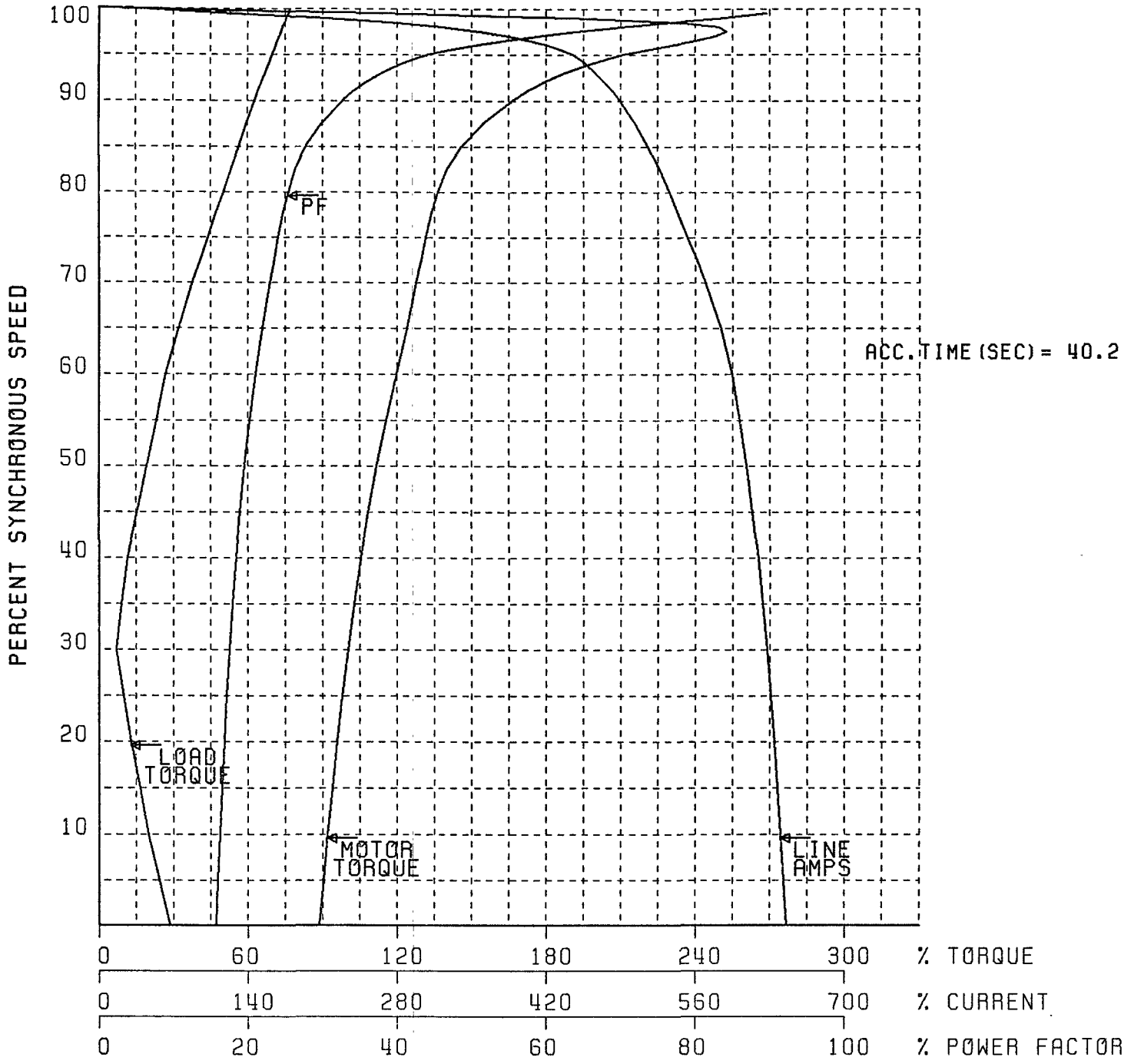
HP 4000 166AA VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1195

PF 0.89 FL AMPS 303 LOCK AMPS (%) 644 RPM (SYN) 1200

FL TORQUE (LB-FT) 17582 LOCK TORQUE (%) 89

LOAD WK² (LB-FT²) 152185 MOTOR WK² (LB-FT²) 9393 FRAME 8018

LOAD CURVE 7-7-81-2 APPLICATION PRIMARY AIR FAN



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal DATE: 12/29/82 CURVE NO. DHC0182010

IP12_001841

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 90 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER S P BANSAL

S.O. 0166788 166848 C.O. CL30900 C.O. 336618DH

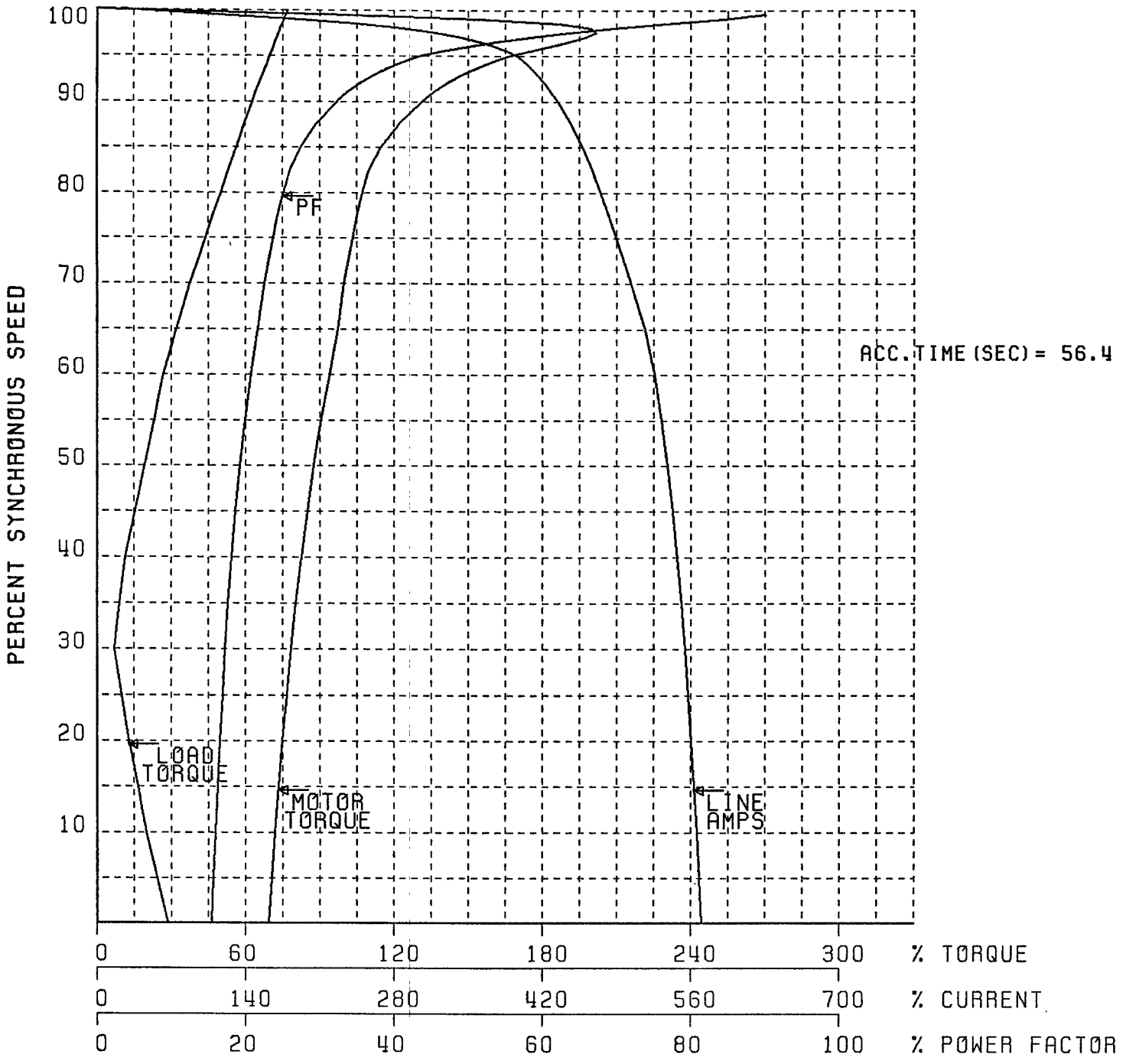
HP 4000 VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1195

PF 0.89 FL AMPS 303 LOCK AMPS (%) 569 RPM (SYN) 1200

FL TORQUE (LB-FT) 17582 LOCK TORQUE (%) 69

LOAD WK² (LB-FT²) 152185 MOTOR WK² (LB-FT²) 9393 FRAME 8018

LOAD CURVE 7-7-81-2 APPLICATION PRIMARY AIR FAN



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal DATE: 12/29/82 CURVE NO. DHC0182010

IP12_001842

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 85 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER S P BANSAL

S.O. 01667AA G.O. CL30900 C.O. 336618DH

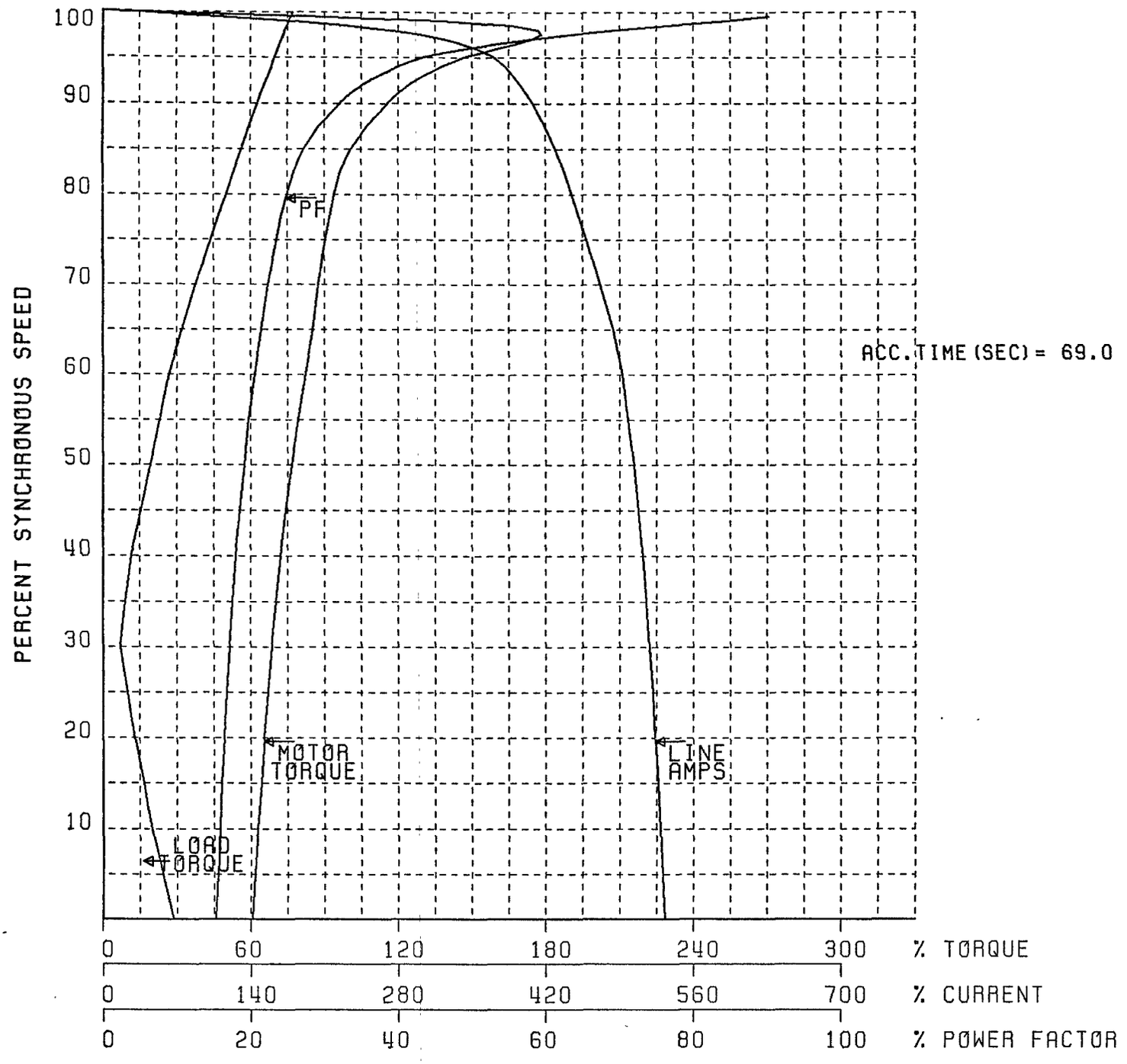
HP 4000 VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1195

PF 0.89 FL AMPS 303 LOCK AMP (%) 532 RPM (SYN) 1200

FL TORQUE (LB-FT) 17582 LOCK TORQUE (%)

LOAD WK² (LB-FT²) 152185 MOTOR WK² (LB-FT² 9393 FRAME 8018

LOAD CURVE 7-7-81-2 APPLICATION PRIMARY AIR FAN



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

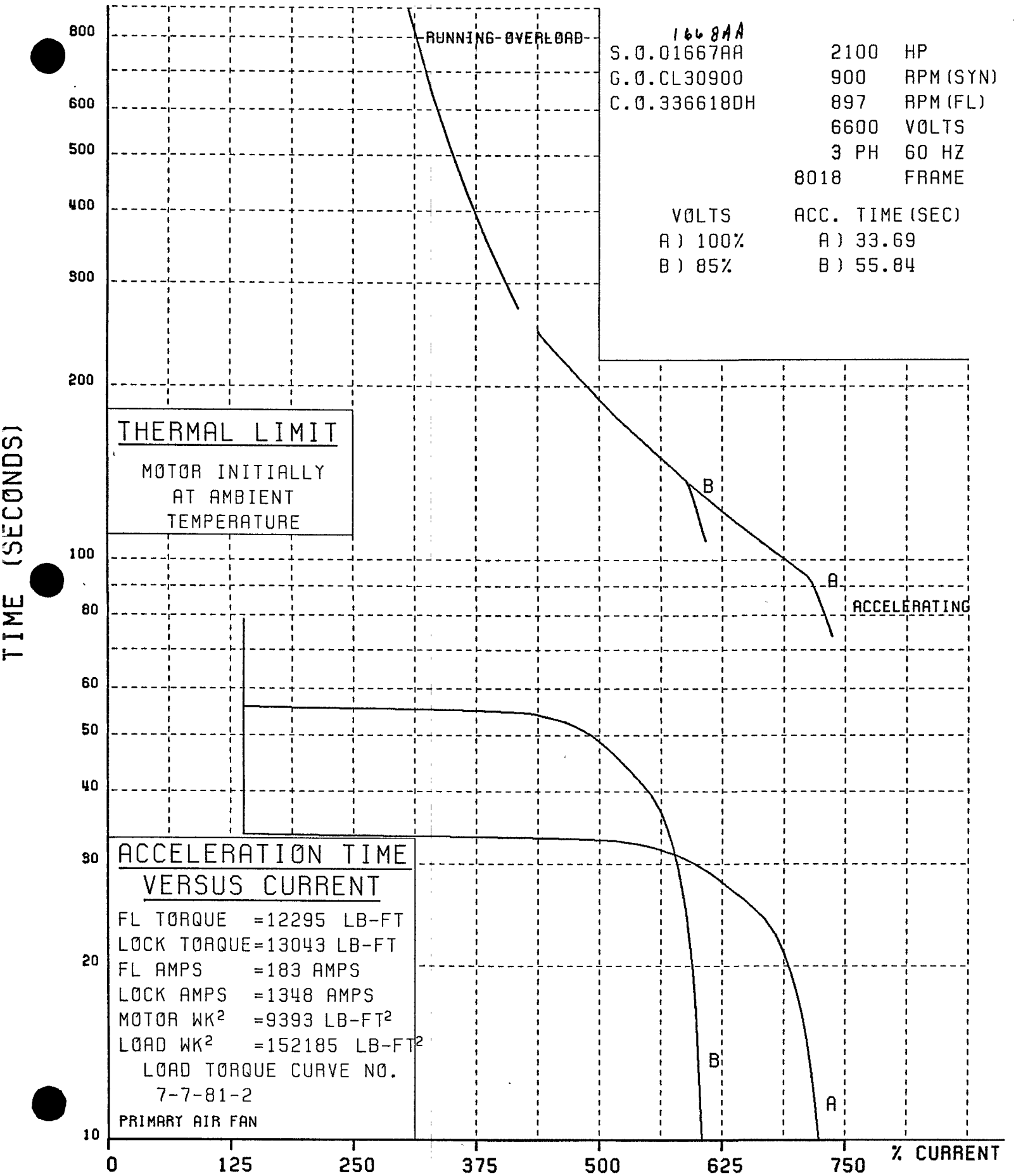
SIGNATURE: S P Bansal DATE: 12/29/82 CURVE NO. DHC0182010

IP12_001843

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: S P BANSAL



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: [signature]

DATE: 12/29/82

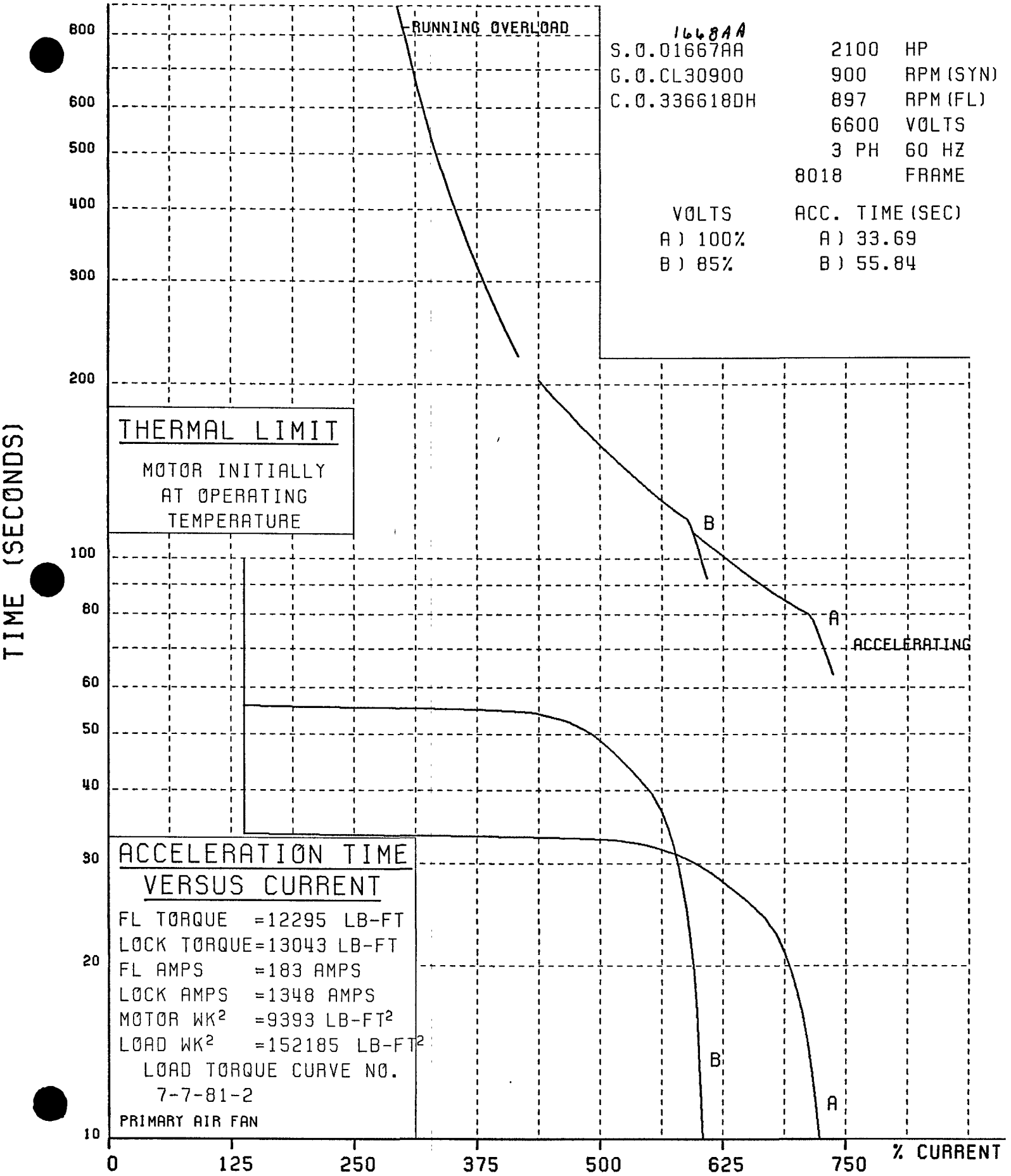
CURVE NO. 0HC0182010

IP12_001844

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: S P BANSAL



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

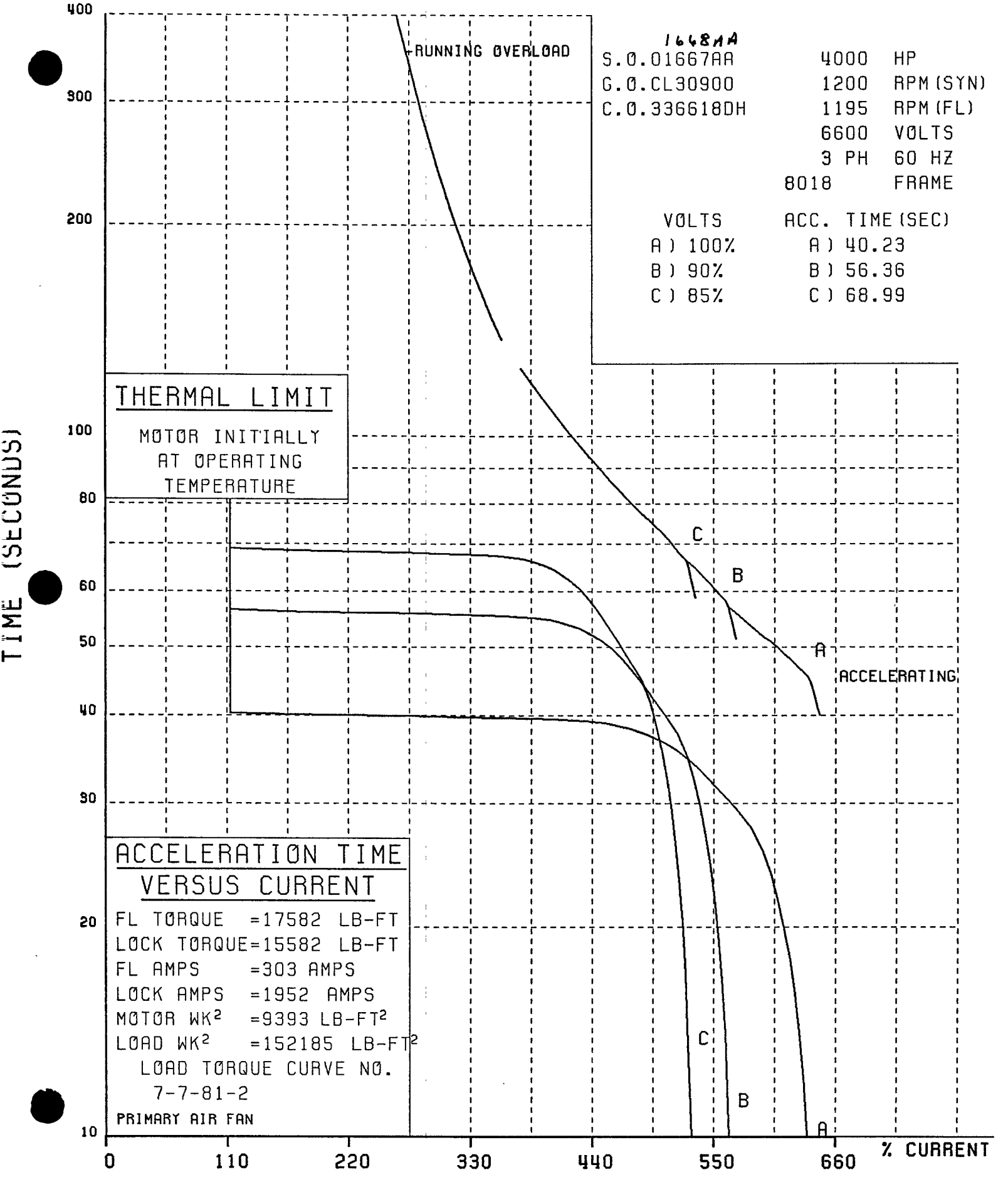
SIGNATURE: [illegible] DATE: 12/29/82 CURVE NO. DHC0182010

IP12_001845

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: S P BANSAL



1668AA

S.0.01667AA	4000	HP
G.0.CL30900	1200	RPM (SYN)
C.0.336618DH	1195	RPM (FL)
	6600	VOLTS
	3 PH	60 HZ
	8018	FRAME

VOLTS	ACC. TIME (SEC)
A) 100%	A) 40.23
B) 90%	B) 56.36
C) 85%	C) 68.99

WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal

DATE: 12/29/82

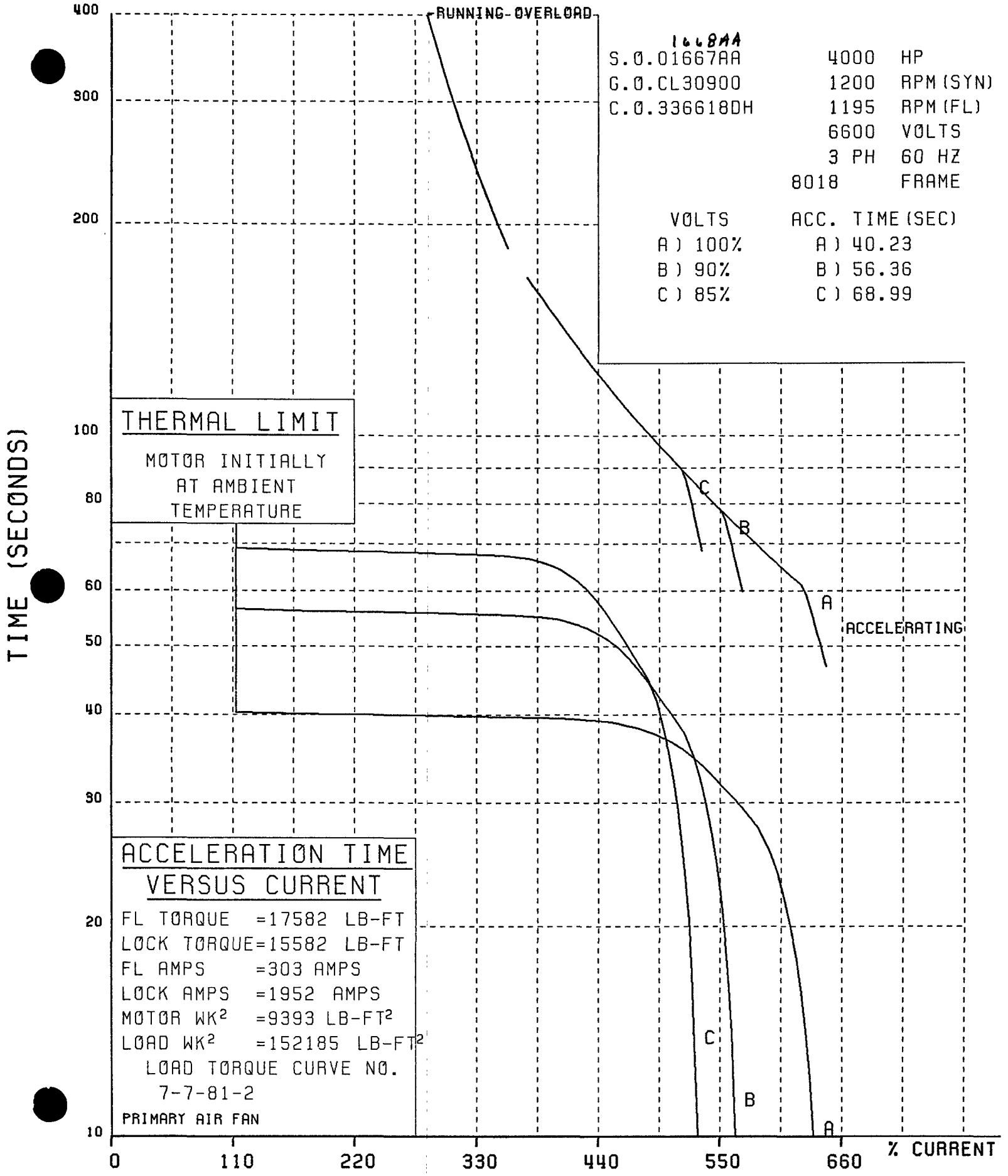
CURVE NO. DHC0182010

IP12_001846

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: S P BANSAL



WESTINGHOUSE ELECTRIC CORPORATION - HIMD ROUND ROCK, TEXAS

SIGNATURE: S P Bansal

DATE: 12/29/82

CURVE NO. DHC0182010

IP12_001847

S. Bansal

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - MAY 14 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01
FRAME - 800-1800S70 TYPE - LLD-CS-PAM S.F. - 1.00 H.P. - 4000
STATOR NO. - AC2405 ROTOR NO. - AD2685 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 6 PHASE - 3 HERTZ - 60 AMPS - 303
0.1126 SEC.V. - 0 SEC.A. - 0 RPM - 1195
0.1123 AIR GAP MEASUREMENTS
0.1124

STATOR CONN - WYE	.090	.095	.090	.095
ROTOR RES. AT 0.0 C		FRONT		REAR
0.0				
0.0		.094		.094
0.0	.095	.095	.095	.095

SPECIFIED AIR GAP .102
(INDEX FROM BOTTOM C.L.)

PHASE ROTATION T4,T6,T5 CCW
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.960 FLOAT IN - 3.720 FLOAT OUT - 4.220

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6624.	6648.	6636.	83.	84.	84.	49.0	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK, VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.150 MILS	H 0.130 MILS	H 0.0 MILS	H 0.270 MILS
V 0.140 MILS	V 0.100 MILS	V 0.0 MILS	V 0.230 MILS
A 0.320 MILS	A 0.220 MILS		

TEMPERATURE DATA - DEG C TIME - 1800 ROOM AIR - 26.6

FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	61.8	RR BRG (CUST) -	57.6
FR BRG,OIL IN -	0.0	RR BRG,OIL IN -	0.0
FR BRG,OIL OUT-	0.0	RR BRG,OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0

FLOW DATA - GPM

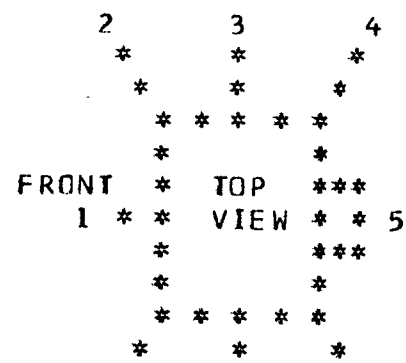
FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS,PSIG-	0.0	WATER -	0.0

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - MAY 14 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	80.6	6	79.8
2	81.1	7	82.0
3	83.9	8	78.5
4	81.4	AMBIENT	77.3
5	78.0	INSULATION	

INSULATION RESISTANCE (MEGOHMS)

	FINAL
STATOR -	12000.00
ROTOR -	0.0
RTD'S -	2600.00
SP.HEATER -	12000.00

TEST FOR 1 MINUTE VOLTS	SPACE HEATER	RESISTANCE
14200.	1	42.30
0.	2	0.0
1500.	3	0.0
1200.		

POLARIZATION INDEX - 0.0

STATOR DETECTOR RESIST	AFTER DIELECTRIC
RES SET 1	10.09
RES SET 2	10.1
RES SET 3	10.1
RES SET 4	10.09
RES SET 5	10.11
RES SET 6	10.11
RES SET 7	10.09

TEMPERATURE AT INITIAL READING, DEG C: 24.

BEARING INSULATION (MEGOHMS): 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	24.3
BRG. REAR	24.2

	PROBE NO. 1	PROBE NO. 2		PROBE NO. 1	PROBE NO. 2
FR.TRUTH TRACK SLOW ROLL	0.0	0.0	R.VOLTS&HZ	0.0	0.0
RR.TRUTH TRACK SLOW ROLL	0.0	0.0	R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

NOISE TEST SHEET SHEET 1

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-01
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	76.3	75.6	75.8	76.8	76.0	75.7	74.0	76.5
160								
200								
250	81.0	79.8	80.4	79.4	78.4	77.4	79.3	77.4
315								
400								
500	78.3	77.3	79.0	77.3	75.6	76.2	78.2	76.3
630								
800								
1K	76.2	74.8	75.2	75.4	71.2	72.2	75.3	73.3
1.3K								
1.6K								
2K	73.6	74.6	80.7	76.0	72.3	75.7	77.0	71.6
2.5K								
3.2K								
4K	67.6	68.2	75.7	70.1	66.5	70.0	71.6	64.4
5K								
6.3K								
8K	58.0	60.4	68.7	59.8	57.2	58.4	65.6	56.0
10K								
A	80.6	81.1	83.9	81.4	78.0	79.8	82.0	78.5
C	86.2	85.6	87.8	86.2	85.0	84.2	88.9	83.4
LIN	87.2	86.5	89.7	87.2	86.2	84.6	89.8	85.2

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET SHEET 2

CUSTOMER - INTERMCUNTAIN SHOP ORDER NO - 1668AA-01
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	73.4	72.7	72.9	72.8	72.2	74.9	71.2	72.7
160								
200								
250	76.3	76.1	75.3	74.4	73.4	73.7	74.9	74.7
315								
400								
500	72.7	72.2	71.7	70.6	70.1	70.8	72.1	72.3
630								
800								
1K	74.0	70.2	69.4	71.1	70.6	70.9	71.2	72.7
1.3K								
1.6K								
2K	68.0	66.7	66.1	64.7	64.1	64.9	65.6	66.7
2.5K								
3.2K								
4K	62.2	61.1	60.0	59.4	57.8	59.4	60.4	61.6
5K								
6.3K								
8K	52.5	51.7	50.3	48.8	47.8	49.5	51.4	52.2
10K								
A	77.4	75.4	74.5	73.9	72.9	75.1	74.4	75.6
C	83.2	81.5	81.7	83.4	82.6	84.1	82.4	81.8
LIN	83.0	82.5	81.7	83.4	82.6	84.1	82.4	81.8

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

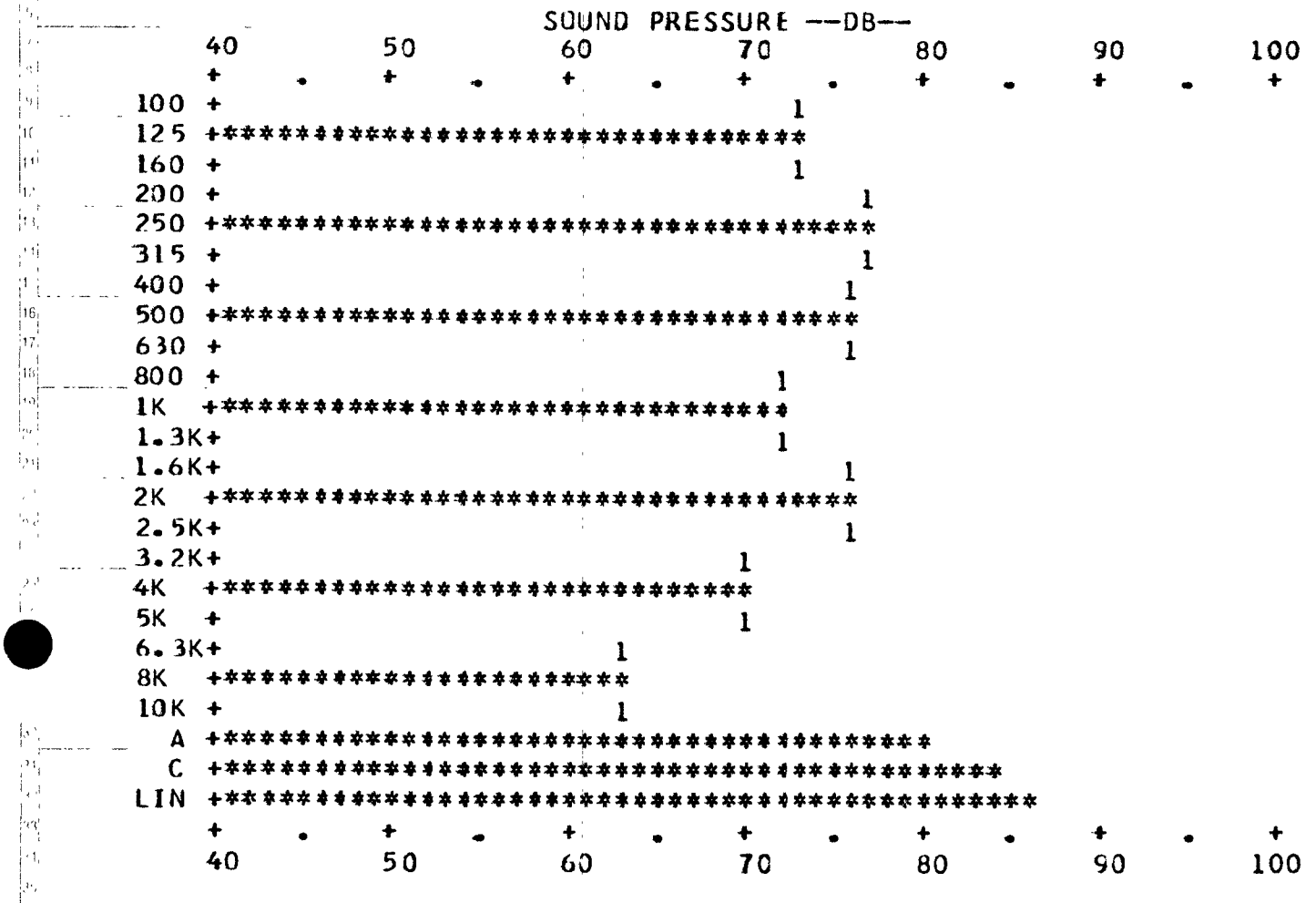
NOISE TEST SHEET SHEET 3

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-01

HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985

FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT

DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	73.2	77.3	76.1	72.2	75.7	70.1	62.5	79.8	84.2	85.8
					(SUM OF OCTAVE BANDS)				80.3	82.6	82.6
LP(3FT)	MAX	74.6	79.2	78.1	73.9	80.5	75.6	68.6	83.4	87.8	89.0
		(4)	(1)	(3)	(3)	(3)	(3)	(3)	(3)	(7)	(3)
LP(3FT)	MIN	71.0	74.4	74.1	68.2	69.9	61.4	53.7	75.5	80.4	81.6
		(7)	(8)	(8)	(5)	(8)	(8)	(8)	(8)	(8)	(6)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - L Bansal 6-10-85

IP12_001852

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01

4000 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 1195 RPM 60 HERTZ 6 POLES

STATOR NO. - AC2405 ROTOR NO. - AD2685

STATOR RESISTANCE TERMINAL TO TERMINAL 0.112 AT 25 DEGREES C.
AIR GAP - FRONT 0.094 - REAR 0.094

PHASE ROTATION T4,T6,T5 CCW SHAFT VOLTAGE - 0.160

MAGNETIC CENTER - 3.960 FLOAT IN - 3.720 FLOAT OUT - 4.220
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6636. VOLTS	83.7 AMPS	49.0 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 61.8 REAR 57.6 AMBIENT AIR 26.6

VIBRATION

	BRACKET FRONT	BRACKET REAR	SHAFT
HORIZONTAL	0.150 MILS	0.130 MILS	0.270 MILS
VERTICAL	0.140 MILS	0.100 MILS	0.230 MILS
AXIAL	0.320 MILS	0.220 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE
STATOR	12000.00 MEGOHMS	14200. VOLTS
ROTOR	0.0 MEGOHMS	0. VOLTS
RTD'S	2600.00 MEGOHMS	1500. VOLTS
SPACE HEATER	12000.00 MEGOHMS	1200. VOLTS

LOCKED ROTOR DATA (PER UNIT VALUES AT RATED VOLTAGE)

VOLTS V1-2	VOLTS V2-3	VOLTS V3-1	AMPS A1	AMPS A2	AMPS A3	KILO-WATTS	TORQUE LB. FT
4920	4944	4932	1452	1460	1456	2304	8875
AVERAGE VALUES PER UNIT			6.43				1.1

BEARINGS HAVE BEEN INSPECTED AND APPROVED FOR SHIPMENT
NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - [signature] DATE - 5-30-85
TEST ENGINEER

SIGNED - [signature] DATE - 6-10-85
DESIGN ENGINEER

IP12_001853

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - MAY 14 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01
FRAME - 800-1800S70 TYPE - LLD-CS-PAM S.F. - 1.00 H.P. - 2100
STATOR NO. - AC2405 ROTOR NO. - AD2685 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 8 PHASE - 3 HERTZ - 60 AMPS - 183
0.1496 SEC.V. - 0 SEC.A. - 0 RPM - 897
0.1495 AIR GAP MEASUREMENTS
0.1498

STATOR CONN - DELTA .090 * * .095 .090 * * .095
ROTOR RES. AT 0.0 C * FRONT * * REAR *
0.0 * * * *
0.0 * .094 * * .094 *
0.0 .095 * * .095 .095 * * .095

SPECIFIED AIR GAP .102
(INDEX FROM BOTTOM C.L.)

PHASE ROTATION T1,T2,T3 CCW
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.960 FLOAT IN - 3.720 FLOAT OUT - 4.220

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6606.	6613.	6612.	101.	100.	100.	38.9	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK, VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.270 MILS	H 0.170 MILS	H 0.0 MILS	H 0.640 MILS
V 0.260 MILS	V 0.260 MILS	V 0.0 MILS	V 0.200 MILS
A 0.460 MILS	A 0.380 MILS		

TEMPERATURE DATA - DEG C TIME - 1915 ROOM AIR - 26.1

FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	54.8	RR BRG (CUST) -	51.4
FR BRG,OIL IN -	0.0	RR BRG,OIL IN -	0.0
FR BRG,OIL OUT-	0.0	RR BRG,OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0

FLOW DATA - GPM

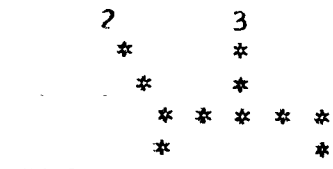
FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS,PSIG-	0.0	WATER -	0.0

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - MAY 14 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	78.2	6	77.0
2	78.5	7	80.1
3	79.2	8	78.2
4	76.6	AMBIENT	75.6
5	76.1	INSULATION	

INSULATION RESISTANCE (MEGOHMS)

	FINAL	TEST FOR 1 MINUTE VOLTS
STATOR -	12000.00	14200.
ROTOR -	0.0	0.
RTD'S -	2600.00	1500.
SP.HEATER -	12000.00	1200.

POLARIZATION INDEX - 0.0

SPACE HEATER	RESISTANCE
1	42.30
2	0.0
3	0.0

STATOR DETECTOR RESIST

	AFTER DIELECTRIC
RES SET 1	10.09
RES SET 2	10.1
RES SET 3	10.1
RES SET 4	10.09
RES SET 5	10.11
RES SET 6	10.11
RES SET 7	10.09

TEMPERATURE AT INITIAL READING, DEG C: 24.

BEARING INSULATION (MEGOHMS): 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	24.3
BRG. REAR	24.2

	PROBE NO. 1	PROBE NO. 2
FR.TRUTH TRACK SLOW ROLL	0.0	0.0
RR.TRUTH TRACK SLOW ROLL	0.0	0.0

	PROBE NO. 1	PROBE NO. 2
R.VOLTS&HZ	0.0	0.0
R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

NOISE TEST SHEET SHEET 1

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-01

HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985

FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT

DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	77.0	76.3	79.0	77.2	75.2	74.2	76.5	77.3
160								
200								
250	78.2	76.2	79.2	76.5	76.4	76.1	77.7	78.1
315								
400								
500	74.9	73.4	74.0	72.7	72.2	72.5	73.2	73.8
630								
800								
1K	76.5	76.1	73.4	71.5	70.8	71.7	71.4	75.7
1.3K								
1.6K								
2K	70.4	68.7	75.5	72.2	70.2	70.3	78.1	72.2
2.5K								
3.2K								
4K	62.2	61.5	61.8	60.9	58.9	60.4	62.2	62.0
5K								
6.3K								
8K	52.5	51.2	51.9	50.1	48.2	50.4	52.4	51.5
10K								
A	78.2	78.5	79.2	76.6	76.1	77.0	80.1	78.2
C	84.5	84.4	85.1	83.7	83.2	82.7	83.9	83.8
LIN	86.1	84.5	86.5	85.5	83.2	84.1	85.7	84.7

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET

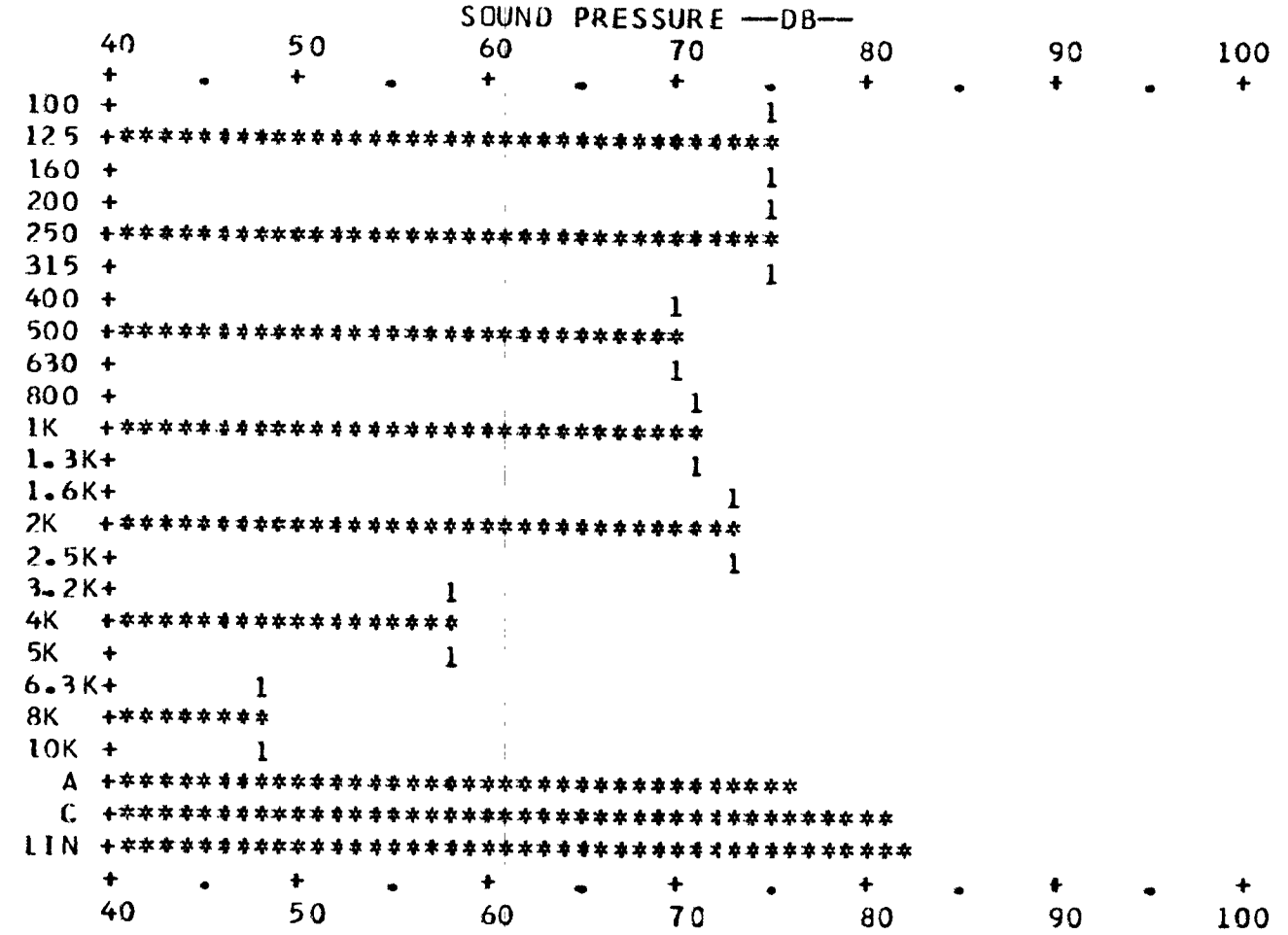
CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-01
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985
FRAME - 800-1800S70 ENCLOSURE - CP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	73.4	72.7	72.9	72.8	72.2	74.9	71.2	72.7
160								
200								
250	76.3	76.1	75.3	74.4	73.4	73.7	74.9	74.7
315								
400								
500	72.7	72.2	71.7	70.6	70.1	70.8	72.1	72.3
630								
800								
1K	74.0	70.2	69.4	71.1	70.6	70.9	71.2	72.7
1.3K								
1.6K								
2K	68.0	66.7	66.1	64.7	64.1	64.9	65.6	66.7
2.5K								
3.2K								
4K	62.2	61.1	60.0	59.4	57.8	59.4	60.4	61.6
5K								
6.3K								
8K	52.5	51.7	50.3	48.8	47.8	49.5	51.4	52.2
10K								
A	77.4	75.4	74.5	73.9	72.9	75.1	74.4	75.6
C	83.2	81.5	81.7	83.4	82.6	84.1	82.4	81.8
LIN	83.0	82.5	81.7	83.4	82.6	84.1	82.4	81.8

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET SHEET 3

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-01
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 14 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	74.8	74.6	70.4	71.5	72.5	58.4	48.2	75.8	81.0	82.4
					(SUM OF OCTAVE BANDS)				76.9	80.1	80.1
LP(3FT)	MAX	77.8 (3)	76.9 (3)	71.9 (1)	74.8 (2)	77.8 (7)	59.2 (7)	49.5 (1)	78.7 (7)	82.4 (3)	84.8 (3)
LP(3FT)	MIN	71.2 (6)	73.1 (6)	69.2 (5)	67.8 (5)	65.7 (2)	55.9 (5)	45.2 (5)	73.3 (5)	79.7 (6)	80.2 (5)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - _____

IP12_001858

FILE: DATA OUTPUT A BUFFALO DATA CENTER VM/SP RELEASE 3.1

POLARIZATION INDEX DATA

CUSTOMER	SHOP ORDER	DATE
INTERMOUNTAIN POWER	1668AA-01	MAY 15 1985

APPLIED VOLTS	POWER SUPPLY SERIAL NO.	TEMPERATURE (DRY BULB)	TEMPERATURE (WET BULB)	RELATIVE HUMIDITY
8250	48323	23.00	18.50	64 %

INSULATION RESISTANCE AT 23.0 DEG C

TIME	PHASE A MEGOHMS	PHASE B MEGOHMS	PHASE C MEGOHMS
15 SEC	2475	3300	3960
30 SEC	7013	7178	8250
45 SEC	10313	10313	12375
1 MIN	14025	13613	16500
2 MIN	24750	23925	28875
3 MIN	33000	33000	41250
4 MIN	41250	45375	49500
5 MIN	49500	49500	57750
6 MIN	57750	57750	66000
7 MIN	66000	66000	74250
8 MIN	74250	74250	82500
9 MIN	82500	82500	82500
10 MIN	82500	82500	82500

INSULATION RESISTANCE CORRECTED TO 40 DEG C

	PHASE A	PHASE B	PHASE C
15 SEC	841	1122	1346
30 SEC	2384	2440	2805
45 SEC	3506	3506	4207
1 MIN	4768	4628	5610
2 MIN	8415	8134	9817
3 MIN	11220	11220	14025
4 MIN	14025	15427	16830
5 MIN	16830	16830	19635
6 MIN	19635	19635	22440
7 MIN	22440	22440	25245
8 MIN	25245	25245	28050
9 MIN	28050	28050	28050
10 MIN	28050	28050	28050

POLARIZATION INDEX FOR EACH PHASE

PHASE A	PHASE B	PHASE C
5.88	6.06	5.00

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-01

2100 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 897 RPM 60 HERTZ 8 POLES

STATOR NO. - AC2405 ROTOR NO. - AD2685

STATOR RESISTANCE TERMINAL TO TERMINAL C.150 AT 25 DEGREES C.
AIR GAP - FRONT 0.094 - REAR 0.094

PHASE ROTATION T1,T2,T3 CCW SHAFT VOLTAGE - 0.130

MAGNETIC CENTER - 3.960 FLOAT IN - 3.720 FLOAT OUT - 4.220
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6610. VOLTS	100.4 AMPS	38.9 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 54.8 REAR 51.4 AMBIENT AIR 26.1

VIBRATION

	BRACKET		
	FRONT	REAR	SHAFT
HORIZONTAL	0.270 MILS	0.170 MILS	0.640 MILS
VERTICAL	0.260 MILS	0.260 MILS	0.200 MILS
AXIAL	0.460 MILS	0.380 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE
STATOR	12000.00 MEGOHMS	14200. VOLTS
ROTOR	0.0 MEGOHMS	0. VOLTS
RTD'S	2600.00 MEGOHMS	1500. VOLTS
SPACE HEATER	12000.00 MEGOHMS	1200. VOLTS

LOCKED ROTOR DATA (PER UNIT VALUES AT RATED VOLTAGE)

VOLTS			AMPS			KILO-	TORQUE
V1-2	V2-3	V3-1	A1	A2	A3	WATTS	LB. FT
5724	5736	5760	1264	1256	1256	2304	11150
AVERAGE VALUES PER UNIT			7.94				1.2

BEARINGS HAVE BEEN INSPECTED AND APPROVED FOR SHIPMENT
NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - [signature] DATE - 5-30-85
TEST ENGINEER

SIGNED - [signature] DATE - 6-10-85
DESIGN ENGINEER

IP12_001860

S. Bansal

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - MAY 23 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02
FRAME - 800-1800S70 TYPE - LLD-CS-PAM S.F. - 1.00 H.P. - 4000
STATOR NO. - AC2406 ROTOR NO. - AD2684 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 6 PHASE - 3 HERTZ - 60 AMPS - 303
0.1140 SEC.V. - 0 SEC.A. - 0 RPM - 1195
0.1142 AIR GAP MEASUREMENTS
0.1144

STATOR CONN - WYE
ROTOR RES. AT 0.0 C
0.0
0.0
0.0

.100		.090	.100	.095
	FRONT		REAR	
	.096		.099	
.095		.100	.100	.100

SPECIFIED AIR GAP .102
(INDEX FROM BOTTOM C.L.)

PHASE ROTATION T4,T6,T5 CCW
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.960 FLOAT IN - 3.700 FLOAT OUT - 4.200

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6600.	6602.	6601.	84.	84.	84.	51.8	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK, VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.560 MILS	H 0.520 MILS	H 0.0 MILS	H 0.850 MILS
V 0.140 MILS	V 0.070 MILS	V 0.0 MILS	V 0.250 MILS
A 0.280 MILS	A 0.200 MILS		

TEMPERATURE DATA - DEG C TIME - 1200 ROOM AIR - 26.5

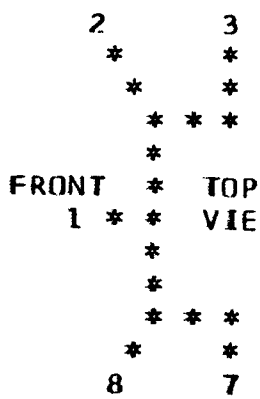
FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	61.9	RR BRG (CUST) -	58.0
FR BRG,OIL IN -	0.0	RR BRG,OIL IN -	0.0
FR BRG,OIL OUT-	0.0	RR BRG,OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0
FLOW DATA - GPM			
FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS,PSIG-	0.0	WATER -	0.0

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - MAY 23 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	79.9	6	81.8
2	80.6	7	80.4
3	83.6	8	81.8
4	79.9	AMBIENT	74.2
5	81.4	INSULATION	

INSULATION RESISTANCE (MEGOHMS)

	FINAL
STATOR -	3800.00
ROTOR -	0.0
RTD'S -	2500.00
SP.HEATER -	50000.00

TEST FOR 1 MINUTE VOLTS

14200.
0.
1500.
1200.

SPACE HEATER RESISTANCE

1	41.80
2	0.0
3	0.0

POLARIZATION INDEX - 0.0

STATOR DETECTOR RESIST

	AFTER DIELECTRIC
RES SET 1	10.14
RES SET 2	10.15
RES SET 3	10.13
RES SET 4	10.13
RES SET 5	10.16
RES SET 6	10.19
RES SET 7	10.16

TEMPERATURE AT INITIAL READING, DEG C: 23.

BEARING INSULATION (MEGOHMS): 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	23.4
BRG. REAR	23.1

	PROBE NO. 1	PROBE NO. 2
FR.TRUTH TRACK SLOW ROLL	0.0	0.0
RR.TRUTH TRACK SLOW ROLL	0.0	0.0

	PROBE NO. 1	PROBE NO. 2
R.VOLTS&HZ	0.0	0.0
R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

NOISE TEST SHEET SHEET 1

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-02

HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985

FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT

DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	76.4	77.0	76.5	75.6	77.0	76.2	76.4	78.5
160								
200								
250	81.8	80.7	79.6	78.8	79.1	78.2	77.6	79.2
315								
400								
500	77.7	78.3	77.3	77.0	76.4	77.3	76.4	77.7
630								
800								
1K	74.3	75.3	76.7	75.1	73.3	73.2	73.1	74.0
1.3K								
1.6K								
2K	75.5	76.2	80.8	73.4	73.2	78.7	80.1	76.1
2.5K								
3.2K								
4K	67.6	70.2	73.4	67.1	66.9	72.4	71.9	70.0
5K								
6.3K								
8K	61.2	61.1	65.4	60.0	57.6	58.2	67.3	61.8
10K								
A	79.9	80.6	83.6	79.9	81.4	81.8	80.4	81.8
C	86.1	86.7	87.1	84.7	85.9	85.1	87.8	85.4
1 IN	87.3	87.9	89.3	86.1	87.1	86.8	98.2	86.2

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659524	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-02
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	71.8	72.2	71.9	72.2	73.8	72.6	70.9	72.2
160								
200								
250	74.9	73.3	74.3	73.5	73.4	72.9	71.9	73.2
315								
400								
500	69.8	70.7	71.2	70.0	72.6	72.0	68.7	70.8
630								
800								
1K	73.3	70.0	71.4	70.9	71.9	70.7	68.1	68.7
1.3K								
1.6K								
2K	64.3	65.4	65.3	64.6	67.3	71.0	63.1	64.6
2.5K								
3.2K								
4K	59.1	59.7	60.6	59.4	61.1	63.0	57.6	59.3
5K								
6.3K								
8K	50.8	51.0	52.1	50.0	58.3	57.0	47.6	50.4
10K								
A	74.6	71.4	74.2	73.7	74.1	78.5	71.2	72.8
C	81.1	80.8	81.2	79.8	81.0	79.9	79.1	79.7
LIN	82.8	83.2	82.8	82.1	83.1	83.1	81.8	81.7

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

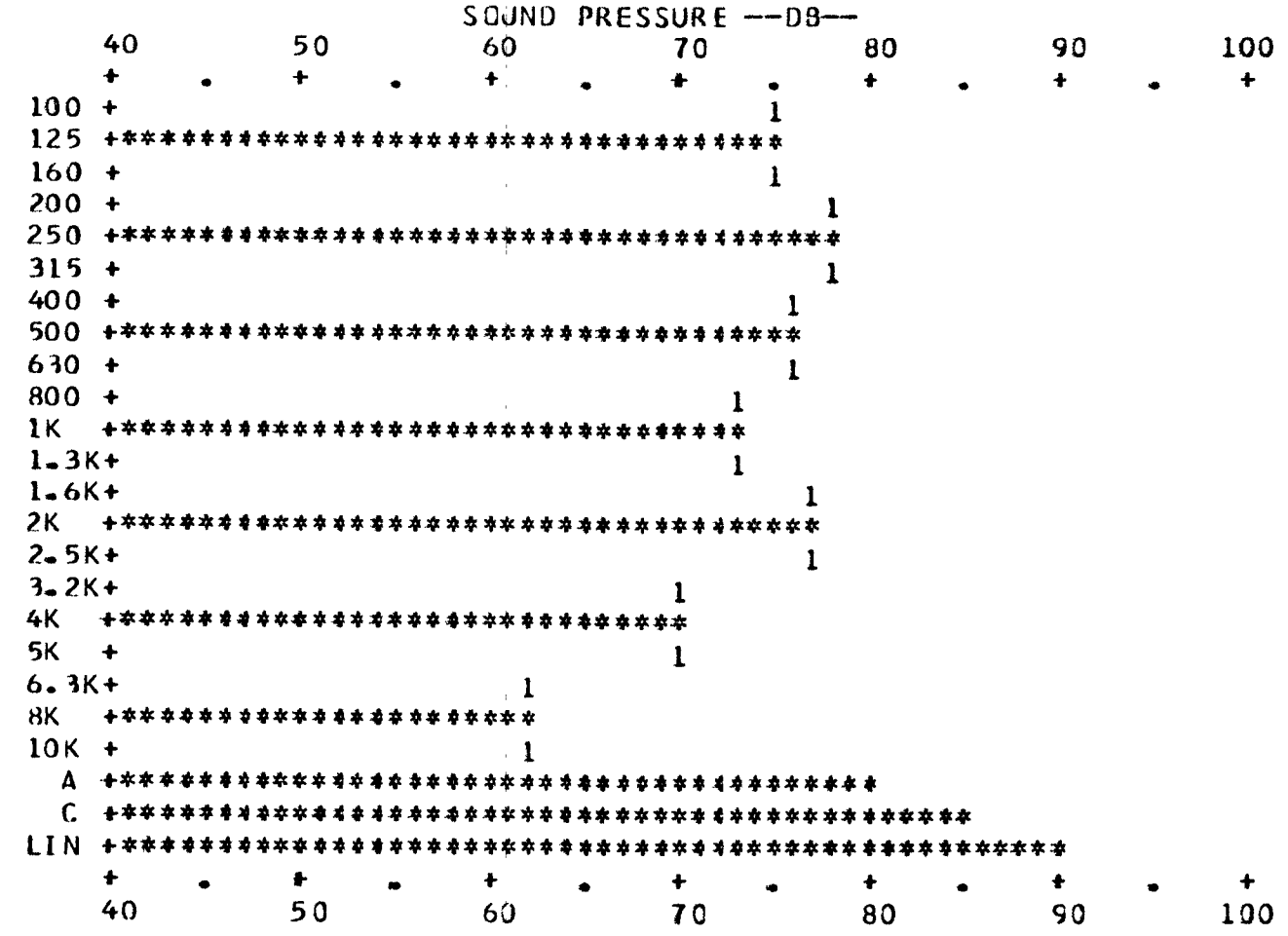
NOISE TEST SHEET SHEET 3

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-02

HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985

FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT

DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	74.9	78.3	76.2	72.5	77.2	70.1	62.4	80.4	84.9	90.5
					(SUM OF OCTAVE BANDS)				81.2	83.5	83.5
LP(3FT)	MAX	77.3 (8)	80.8 (1)	77.5 (2)	75.2 (3)	80.7 (3)	73.2 (3)	67.3 (7)	83.1 (3)	87.2 (7)	98.1 (7)
LP(3FT)	MIN	72.9 (4)	76.2 (7)	74.1 (5)	70.2 (6)	71.9 (5)	65.6 (5)	54.6 (5)	78.4 (1)	83.0 (4)	83.9 (4)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - S.P. Bansal 6-10-85

IP12_001865

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02

4000 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 1195 RPM 60 HERTZ 6 POLES

STATOR NO. - AC2406 ROTOR NO. - AD2684

STATOR RESISTANCE TERMINAL TO TERMINAL 0.114 AT 25 DEGREES C.
AIR GAP - FRONT 0.096 - REAR 0.095

PHASE ROTATION T4,T6,T5 CCW SHAFT VOLTAGE - 0.170

MAGNETIC CENTER - 3.960 FLOAT IN - 3.700 FLOAT OUT - 4.200
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6601. VOLTS	84.1 AMPS	51.8 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 61.9 REAR 58.0 AMBIENT AIR 26.5

VIBRATION

	BRACKET		
	FRONT	REAR	SHAFT
HORIZONTAL	0.560 MILS	0.520 MILS	0.850 MILS
VERTICAL	0.140 MILS	0.070 MILS	0.250 MILS
AXIAL	0.280 MILS	0.200 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE
STATOR	3800.00 MEGOHMS	14200. VOLTS
ROTOR	0.0 MEGOHMS	0. VOLTS
RTD'S	2500.00 MEGOHMS	1500. VOLTS
SPACE HEATER	50000.00 MEGOHMS	1200. VOLTS

LOCKED ROTOR DATA (PER UNIT VALUES AT RATED VOLTAGE)

VOLTS			AMPS			KILO-WATTS	TORQUE LB. FT
V1-2	V2-3	V3-1	A1	A2	A3		
4908	4944	4932	1448	1460	1452	2304	8875
AVERAGE VALUES PER UNIT			6.43				1.1

BEARINGS HAVE BEEN INSPECTED AND APPROVED FOR SHIPMENT
NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - [signature] DATE - 5-24-85
TEST ENGINEER

SIGNED - [signature] DATE - 6-10-85
DESIGN ENGINEER

IP12_001866

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - MAY 23 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02
FRAME - 800-1800S70 TYPE - 11D-CS-PAM S.F. - 1.00 H.P. - 2100
STATOR NO. - AC2406 ROTOR NO. - AD2684 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 8 PHASE - 3 HERTZ - 60 AMPS - 183
0.1505 SEC.V. - 0 SEC.A. - 0 RPM - 897
0.1507 AIR GAP MEASUREMENTS
0.1502

STATOR CONN - DELTA

ROTOR RES. AT 0.0 C

0.0	.100	*	.090	.100	*		.095
0.0		* FRONT *			* REAR *		
0.0		* .096 *			* .099 *		
0.0	.095	*	.100	.100	*		.100

SPECIFIED AIR GAP .102
(INDEX FROM BOTTOM C.L.)

PHASE ROTATION T1,T2,T3 CCW
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.960 FLOAT IN - 3.700 FLOAT OUT - 4.200

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6600.	6602.	6602.	99.	100.	100.	39.4	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK, VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.540 MILS	H 0.600 MILS	H 0.0 MILS	H 0.900 MILS
V 0.320 MILS	V 0.400 MILS	V 0.0 MILS	V 0.280 MILS
A 0.220 MILS	A 0.380 MILS		

TEMPERATURE DATA - DEG C TIME - 1330 ROOM AIR - 26.0

FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	56.1	RR BRG (CUST) -	53.0
FR BRG,OIL IN -	0.0	RR BRG,OIL IN -	0.0
FR BRG,OIL OUT-	0.0	RR BRG,OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0

FLOW DATA - GPM

FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS,PSIG-	0.0	WATER -	0.0

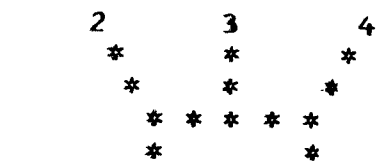
CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02

IP12_001867

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - MAY 23 1985

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	75.6	6	77.6
2	78.8	7	80.6
3	81.3	8	76.7
4	76.6	AMBIENT	74.7
5	77.0		

INSULATION RESISTANCE (MEGOHMS)

	FINAL
STATOR -	3800.00
ROTOR -	0.0
RTD'S -	2500.00
SP.HEATER -	50000.00

POLARIZATION INDEX - 0.0

TEST FOR 1 MINUTE VOLTS
14200.
0.
1500.
1200.

	SPACE HEATER RESISTANCE
1	41.80
2	0.0
3	0.0

STATOR DETECTOR RESIST

	AFTER DIELECTRIC
RES SET 1	10.14
RES SET 2	10.15
RES SET 3	10.13
RES SET 4	10.13
RES SET 5	10.16
RES SET 6	10.19
RES SET 7	10.16

TEMPERATURE AT INITIAL READING, DEG C: 25.

BEARING INSULATION (MEGOHMS): 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	23.4
BRG. REAR	23.1

	PROBE NO. 1	PROBE NO. 2
FR.TRUTH TRACK SLOW ROLL	0.0	0.0
RR.TRUTH TRACK SLOW ROLL	0.0	0.0

	PROBE NO. 1	PROBE NO. 2
R.VOLTS&HZ	0.0	0.0
R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

NOISE TEST SHEET SHEET 1

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-02
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	80.2	86.6	88.3	77.3	82.2	80.2	88.4	84.8
160								
200								
250	78.1	77.3	77.6	75.7	76.3	76.2	76.7	75.7
315								
400								
500	73.2	73.4	73.7	72.9	73.3	72.2	71.9	72.4
630								
800								
1K	70.3	74.4	72.7	73.5	72.6	68.8	71.4	72.2
1.3K								
1.6K								
2K	69.2	71.1	78.1	67.6	69.0	74.3	76.8	68.2
2.5K								
3.2K								
4K	60.5	60.9	63.1	60.9	60.9	61.3	60.8	60.4
5K								
6.3K								
8K	51.9	52.6	54.8	52.2	51.5	50.3	53.4	51.7
10K								
A	75.6	78.8	81.3	76.6	77.0	77.6	80.6	76.7
C	84.4	87.9	89.4	83.3	84.9	84.0	89.4	86.5
LIN	85.6	88.8	90.6	84.3	86.6	85.4	94.1	87.2

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET

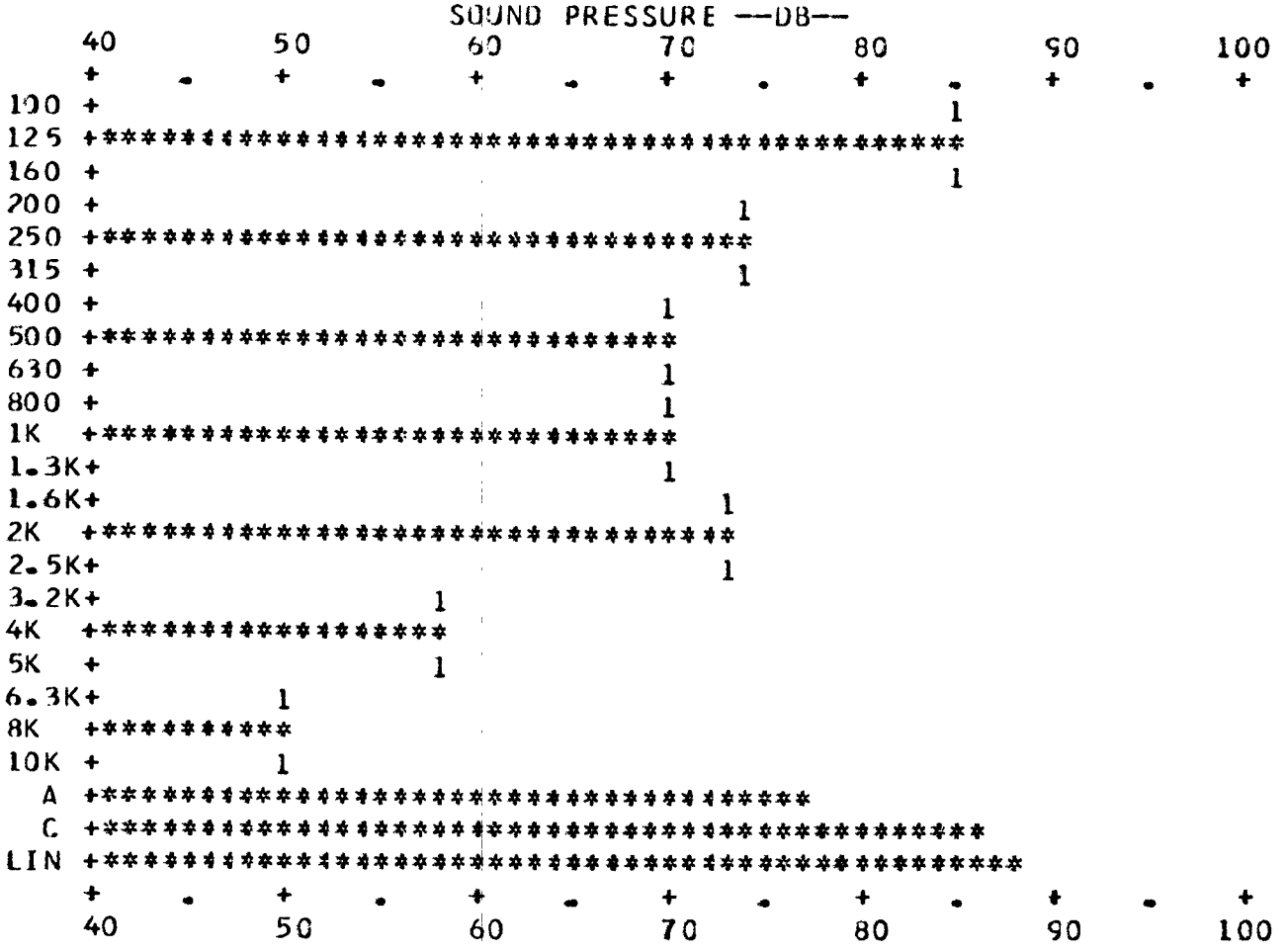
CUSTOMER - INTERMCUNTAIN SHOP ORDER NO - 1668AA-02
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMCND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	71.8	72.2	71.9	72.2	73.8	72.6	70.9	72.2
160								
200								
250	74.9	73.3	74.3	73.5	73.4	72.9	71.9	73.2
315								
400								
500	69.8	70.7	71.2	70.0	72.6	72.0	68.7	70.8
630								
800								
1K	73.3	70.0	71.4	70.9	71.9	70.7	68.1	68.7
1.3K								
1.6K								
2K	64.3	65.4	65.3	64.6	67.3	71.0	63.1	64.6
2.5K								
3.2K								
4K	59.1	59.7	60.6	59.4	61.1	63.0	57.6	59.3
5K								
6.3K								
8K	50.8	51.0	52.1	50.0	58.3	57.0	47.6	50.4
10K								
A	74.6	71.4	74.2	73.7	74.1	78.5	71.2	72.8
C	81.1	80.8	81.2	79.8	81.0	79.9	79.1	79.7
LIN	82.8	83.2	82.8	82.1	83.1	83.1	81.8	81.7

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

NOISE TEST SHEET SHEET 3

CUSTOMER - INTERMOUNTAIN SHOP ORDER NO - 1668AA-02
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - MAY 23 1985
FRAME - 800-1800S70 ENCLOSURE - DP MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	84.8	74.2	70.0	69.6	72.6	58.2	49.8	76.9	85.7	88.0
					(SUM OF OCTAVE BANDS)				77.0	85.5	85.6
LP(3FT)	MAX	88.3	75.3	70.7	72.4	77.9	60.1	52.1	80.4	89.0	93.8
		(7)	(1)	(3)	(2)	(3)	(3)	(7)	(3)	(7)	(7)
LP(3FT)	MIN	75.7	72.7	69.1	65.8	64.6	57.4	47.3	72.6	80.7	81.3
		(4)	(8)	(7)	(6)	(4)	(8)	(6)	(1)	(4)	(4)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	749139	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - _____

IP12_001871

FILE: DATA OUTPUT A BUFFALO DATA CENTER VM/SP RELEASE 3.1

POLARIZATION INDEX DATA

CUSTOMER	SHOP ORDER	DATE
INTERMOUNTAIN	1668AA-02	MAY 23 1985

APPLIED VOLTS	POWER SUPPLY SERIAL NO.	TEMPERATURE (DRY BULB)	TEMPERATURE (WET BULB)	RELATIVE HUMIDITY
8250	46323	24.50	18.50	56 %

INSULATION RESISTANCE AT 24.5 DEG C

TIME	PHASE A MEGOHMS	PHASE B MEGOHMS	PHASE C MEGOHMS
15 SEC	4950	4950	4950
30 SEC	7425	7425	6600
45 SEC	8250	8250	8250
1 MIN	9900	9075	9900
2 MIN	17325	18150	17325
3 MIN	24750	24750	23100
4 MIN	33000	33000	27225
5 MIN	39600	39600	36300
6 MIN	42075	41250	39600
7 MIN	49500	43725	43725
8 MIN	49500	49500	50325
9 MIN	57750	53625	52800
10 MIN	61875	57750	56100

INSULATION RESISTANCE CORRECTED TO 40 DEG C

	PHASE A	PHASE B	PHASE C
15 SEC	1683	1683	1683
30 SEC	2524	2524	2244
45 SEC	2805	2805	2805
1 MIN	3366	3085	3366
2 MIN	5890	6171	5890
3 MIN	8415	8415	7854
4 MIN	11220	11220	9256
5 MIN	13464	13464	12342
6 MIN	14305	14025	13464
7 MIN	16830	14866	14866
8 MIN	16830	16830	17110
9 MIN	19635	18232	17952
10 MIN	21037	19635	19074

POLARIZATION INDEX FOR EACH PHASE

PHASE A	PHASE B	PHASE C
6.25	6.36	5.67

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1668AA-02

2100 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 897 RPM 60 HERTZ 8 POLES

STATOR NO. - AC2406 ROTOR NO. - AD2684

STATOR RESISTANCE TERMINAL TO TERMINAL 0.150 AT 25 DEGREES C.
AIR GAP - FRONT 0.096 - REAR 0.099

PHASE ROTATION T1,T2,T3 CCW SHAFT VOLTAGE - 0.140

MAGNETIC CENTER - 3.960 FLOAT IN - 3.700 FLOAT OUT - 4.200
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6602. VOLTS	99.7 AMPS	39.4 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 56.1 REAR 53.0 AMBIENT AIR 26.0

VIBRATION

	BRACKET FRONT	BRACKET REAR	SHAFT
HORIZONTAL	0.540 MILS	0.600 MILS	0.900 MILS
VERTICAL	0.320 MILS	0.400 MILS	0.280 MILS
AXIAL	0.220 MILS	0.380 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE	
STATOR	3800.00 MEGOHMS	14200.	VOLTS
ROTOR	0.0 MEGOHMS	0.	VOLTS
RTD'S	2500.00 MEGOHMS	1500.	VOLTS
SPACE HEATER	50000.00 MEGOHMS	1200.	VOLTS

LOCKED ROTOR DATA (PER UNIT VALUES AT RATED VOLTAGE)

VOLTS			AMPS			KILO-WATTS	TORQUE LB. FT
V1-2	V2-3	V3-1	A1	A2	A3		
5772	5760	5748	1256	1256	1272	2352	11150
AVERAGE VALUES PER UNIT			7.89				1.2

BEARINGS HAVE BEEN INSPECTED AND APPROVED FOR SHIPMENT
NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - _____ DATE - 5-24-85
TEST ENGINEER

SIGNED - _____ DATE - 6-10-85
DESIGN ENGINEER

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - APRIL 25 1984 S.Bansal

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01
FRAME - 800-1800S70 TYPE - CS-LLD S.F. - 1.00 H.P. - 4000
STATOR NO. - AC1603 ROTOR NO. - AD1510 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 6 PHASE - 3 HERTZ - 60 AMPS - 303
0.1120 SEC.V. - 0 SEC.A. - 0 RPM - 1194
0.1120 AIR GAP MEASUREMENTS
0.1120

STATOR CONN - WYE	.100	*	*	.100	.098	*	* .097
ROTOR RES. AT 0.0 C		*	FRONT	*		* REAR	*
0.0		*		*		*	*
0.0		*	.101	*		* .098	*
0.0	.100	*	*	.105	.097	*	* .102

SPECIFIED AIR GAP .102
(INDEX FROM BOTTOM C.L.)

PHASE ROTATION T4,T6,T5 CCW
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.800 FLOAT IN - 3.480 FLOAT OUT - 3.980

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6605.	6628.	6624.	83.	83.	83.	44.6	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK, VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.540 MILS	H 0.400 MILS	H 0.0 MILS	H 0.860 MILS
V 0.320 MILS	V 0.120 MILS	V 0.0 MILS	V 0.420 MILS
A 0.400 MILS	A 0.300 MILS		

TEMPERATURE DATA - DEG C TIME - 2000 ROOM AIR - 30.5

FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	67.2	RR BRG (CUST) -	57.7
FR BRG,OIL IN -	0.0	RR BRG,OIL IN -	0.0
FR BRG,OIL OUT-	0.0	RR BRG,OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0

FLOW DATA - GPM

FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS,PSIG-	0.0	WATER -	0.0

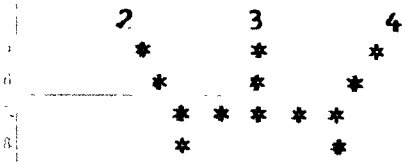
CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01

IP12_001874

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - APRIL 25 1984

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	84.3	6	81.6
2	84.3	7	84.7
3	84.6	8	82.8
4	82.4	AMBIENT	81.1
5	83.4	INSULATION	

INSULATION RESISTANCE (MEGOHMS)

	FINAL
STATOR -	5000.00
ROTOR -	0.0
RTD'S -	2600.00
SP.HEATER -	10000.00

TEST FOR 1 MINUTE VOLTS
14200.
0.
1500.
1200.

	SPACE HEATER RESISTANCE
1	42.70
2	0.0
3	0.0

POLARIZATION INDEX - 0.0

STATOR DETECTOR RESIST

	AFTER DIELECTRIC
RES SET 1	10.2
RES SET 2	10.2
RES SET 3	10.21
RES SET 4	10.22
RES SET 5	10.23
RES SET 6	10.21
RES SET 7	10.17

TEMPERATURE AT INITIAL READING, DEG C 25.

BEARING INSULATION (MEGOHMS) 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	25.1
BRG. REAR	25.3

	PROBE NO. 1	PROBE NO. 2
FR. TRUTH TRACK SLOW ROLL	0.0	0.0
RR. TRUTH TRACK SLOW ROLL	0.0	0.0

	PROBE NO. 1	PROBE NO. 2
R.VOLTS&HZ	0.0	0.0
R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01

4000 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 1194 RPM 60 HERTZ 6 POLES

STATOR NO. - AC1603 ROTOR NO. - AD1510

STATOR RESISTANCE TERMINAL TO TERMINAL .0.112 AT 25 DEGREES C.
AIR GAP - FRONT 0.101 - REAR 0.098

PHASE ROTATION T4,T6,T5 CCW SHAFT VOLTAGE - 0.0

MAGNETIC CENTER - 3.800 FLOAT IN - 3.480 FLOAT OUT - 3.980
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6619. VOLTS	83.0 AMPS	44.6 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 67.2 REAR 57.7 AMBIENT AIR 30.5

VIBRATION

	BRACKET		
	FRONT	REAR	SHAFT
HORIZONTAL	0.540 MILS	0.400 MILS	0.860 MILS
VERTICAL	0.320 MILS	0.120 MILS	0.420 MILS
AXIAL	0.400 MILS	0.300 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE
STATOR	5000.00 MEGOHMS	14200. VOLTS
ROTOR	0.0 MEGOHMS	0. VOLTS
RTD'S	2600.00 MEGOHMS	1500. VOLTS
SPACE HEATER	10000.00 MEGOHMS	1200. VOLTS

BEARINGS INSPECTION COMPLETED AND APPROVED FOR SHIPMENT.

LOCKED ROTOR DATA

VOLTS			AMPERES				LB. FT.
V1-2	V2-3	V3-1	A1	A2	A3	KW	TORQUE
4920.	4932.	4944.	1432.	1432.	1440.	2208.	8775.

INRUSH & TORQUE AT RATED VOLTS - 1920 AMPERES, 15695 LB. FT.

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - [signature] DATE - 4-27-84
TEST ENGINEER

SIGNED - [signature] DATE - 5-2-84
DESIGN ENGINEER

IP12_001876

NOISE TEST SHEET SHEET 1

CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984
FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	81.0	79.0	79.0	79.6	79.2	80.3	76.8	80.6
160								
200								
250	83.7	81.8	81.0	80.2	82.7	80.8	80.8	81.2
315								
400								
500	81.1	79.9	79.5	78.6	78.1	77.3	80.4	79.1
630								
800								
1K	80.3	78.0	78.2	77.4	81.2	77.4	77.3	79.0
1.3K								
1.6K								
2K	74.7	79.8	77.2	74.6	76.6	73.5	82.2	79.1
2.5K								
3.2K								
4K	69.7	73.9	72.4	68.5	69.9	69.3	74.3	72.2
5K								
6.3K								
8K	62.7	65.1	69.8	63.4	61.5	63.2	70.1	65.4
10K								
A	84.3	84.3	84.6	82.4	83.4	81.6	84.7	82.8
C	89.8	89.1	91.8	88.5	88.7	87.5	92.5	88.3
LIN	91.1	90.4	97.2	89.7	90.6	88.9	98.4	89.3

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

NOISE TEST SHEET

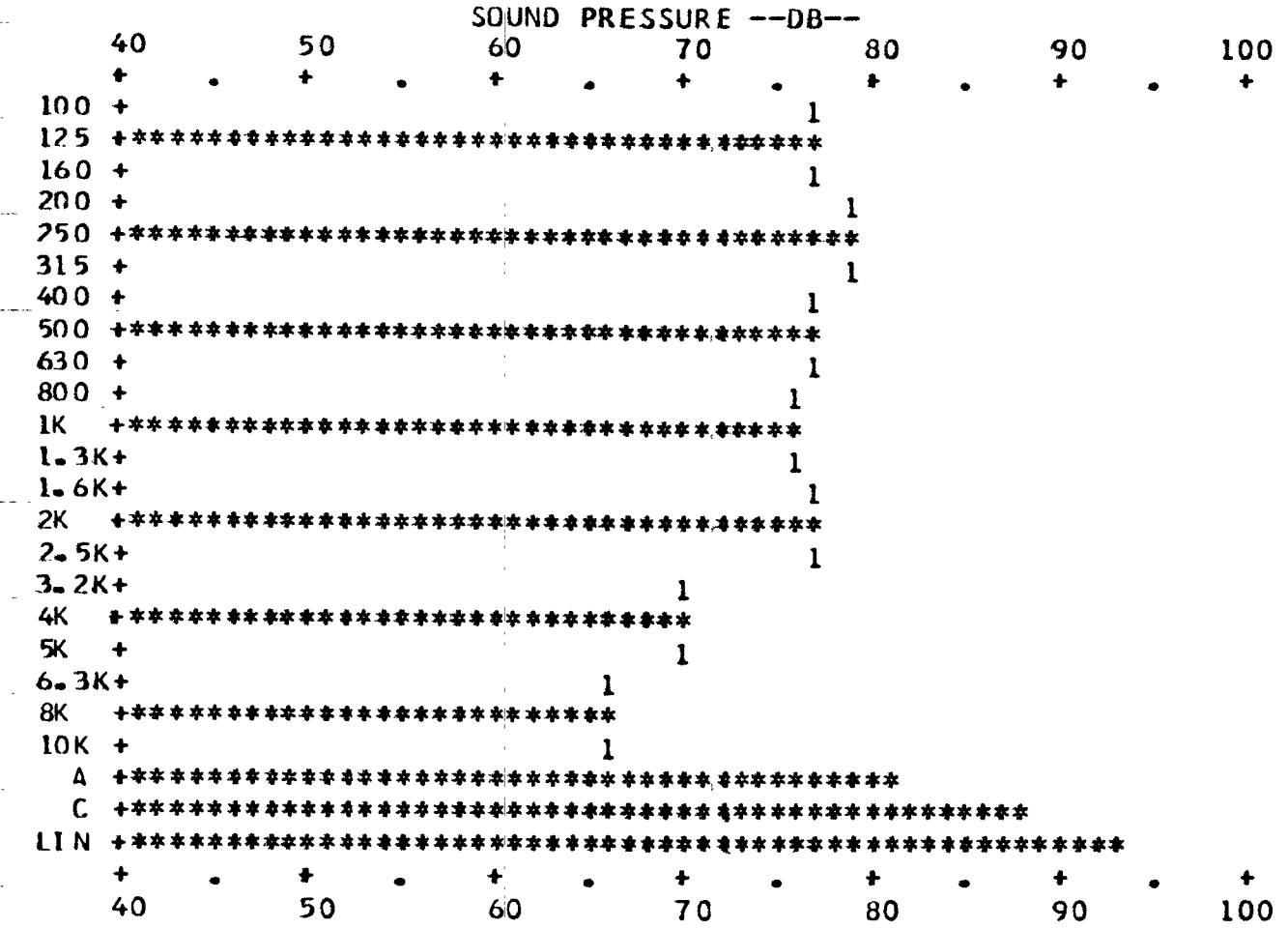
CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984
FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	77.7	77.4	77.3	79.6	78.0	76.8	75.6	78.0
160								
200								
250	78.1	78.4	78.8	77.9	76.3	77.9	77.7	78.3
315								
400								
500	77.2	77.7	77.1	75.3	74.9	75.3	74.8	76.9
630								
800								
1K	80.3	80.6	78.4	80.6	78.8	75.1	77.4	77.9
1.3K								
1.6K								
2K	72.4	72.8	72.0	71.5	70.0	70.2	70.2	71.1
2.5K								
3.2K								
4K	67.5	68.0	67.0	66.3	64.8	64.5	64.4	66.3
5K								
6.3K								
8K	59.1	59.3	59.1	58.0	57.2	55.9	55.6	58.6
10K								
A	82.0	82.2	82.1	82.0	80.0	79.1	82.1	80.3
C	85.7	86.0	86.1	86.7	84.7	83.4	84.5	85.4
LIN	87.3	86.3	87.0	88.0	85.3	84.6	85.6	86.2

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

NOISE TEST SHEET

CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01
HP - 4000. POLES - 6. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984
FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	76.7	79.4	76.9	75.8	77.1	70.4	65.6	80.7	88.0	92.7
					(SUM OF OCTAVE BANDS)				82.0	84.6	84.6
LP(3FT)	MAX	78.3 (1)	82.3 (1)	79.0 (7)	78.2 (5)	81.9 (7)	73.8 (7)	69.9 (7)	81.7 (7)	91.8 (7)	98.2 (7)
LP(3FT)	MIN	73.8 (7)	77.2 (4)	74.3 (6)	74.3 (7)	70.8 (6)	65.5 (4)	59.5 (5)	78.6 (6)	85.3 (8)	86.4 (8)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - S P Bansal

IP12_001879

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 1

DATE - APRIL 25 1984

CUSTOMER - INTERMCUNTAIN POWER S.O. - 1667AA-01
FRAME - 800-1800S70 TYPE - CS-LLD S.F. - 1.00 H.P. - 2100
STATOR NO. - AC1603 ROTOR NO. - AD1510 VOLTS - 6600
STATOR RES. AT 25.0 POLES - 8 PHASE - 3 HERTZ - 60 AMPS - 183
0.1490 SEC.V. - 0 SEC.A. - 0 RPM - 897
0.1490 AIR GAP MEASUREMENTS
0.1490

STATOR CONN - DELTA	.100	*	*	.100	.098	*	* .097
ROTOR RES. AT 0.0 C		*	FRONT *			* REAR *	
0.0		*	*			*	*
0.0		*	.101 *			* .098 *	
0.0	.100	*	*	.105	.097	*	* .102

SPECIFIED AIR GAP .102
PHASE ROTATION T1,T2,T3 CCW (INDEX FROM BOTTOM C.L.)
PER DRAWING NO. - 1897F83
MAGNETIC CENTER - 3.800 FLOAT IN - 3.480 FLOAT OUT - 3.980

	HZ	V 1-2	V 2-3	V 3-1	A 1-2	A 2-3	A 3-1	K-WATT	SECVOLT
1 PT INPUT	60	6605.	6618.	6612.	100.	100.	99.	34.6	

VIBRATION DATA DISPLACEMENT - MILS PEAK-TO-PEAK. VELOCITY - INCHES/SEC

FRONT BRACKET	REAR BRACKET	FRONT SHAFT	REAR SHAFT
H 0.300 MILS	H 0.280 MILS	H 0.0 MILS	H 0.600 MILS
V 0.210 MILS	V 0.180 MILS	V 0.0 MILS	V 0.500 MILS
A 0.380 MILS	A 0.200 MILS		

TEMPERATURE DATA - DEG C TIME - 2200 ROOM AIR - 29.5

FR BRG (TEST) -	0.0	RR BRG (TEST) -	0.0
FR BRG (CUST) -	57.5	RR BRG (CUST) -	50.8
FR BRG.OIL IN -	0.0	RR BRG.OIL IN -	0.0
FR BRG.OIL OUT-	0.0	RR BRG.OIL OUT-	0.0
WATER TEMP IN -	0.0	WATER TEMP OUT-	0.0
FLOW DATA - GPM			
FR BRG OIL -	0.0	REAR BRG OIL -	0.0
OIL PRESS.PSIG-	0.0	WATER -	0.0

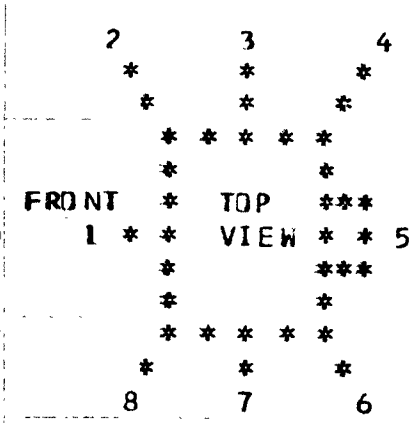
CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01

IP12_001880

HORIZONTAL INDUCTION MOTOR COMMERCIAL TEST SHEET SHEET 2

DATE - APRIL 25 1984

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01



NOTE: NOISE DATA TAKEN WITH A B & K TYPE 2210 W/TYPE 1616 1/3 OCTAVE FILTER SET AT A DISTANCE OF 3.00 FEET BETWEEN THE INSTRUMENT & THE MACHINE UNDER TEST

NOISE DATA

POSITION	DBA	POSITION	DBA
1	84.2	6	80.5
2	83.1	7	84.3
3	83.8	8	81.0
4	81.8	AMBIENT	81.1
5	79.3		

INSULATION RESISTANCE (MEGOHMS)

	FINAL
STATOR -	5000.00
ROTOR -	0.0
RTD'S -	2600.00
SP.HEATER -	10000.00

POLARIZATION INDEX - 0.0

TEST FOR 1 MINUTE VOLTS

	14200.
	0.
	1500.
	1200.

SPACE HEATER RESISTANCE

1	42.70
2	0.0
3	0.0

STATOR DETECTOR RESIST

	AFTER DIELECTRIC
RES SET 1	10.2
RES SET 2	10.2
RES SET 3	10.21
RES SET 4	10.22
RES SET 5	10.23
RES SET 6	10.21
RES SET 7	10.17

TEMPERATURE AT INITIAL READING, DEG C: 25.

BEARING INSULATION (MEGOHMS): 0.0

BEARING TEMP. SENSORS - CHROMEL CONSTANTAN

BRG. FRONT	25.1
BRG. REAR	25.3

	PROBE NO. 1	PROBE NO. 2
FR.TRUTH TRACK		
SLOW ROLL	0.0	0.0
RR.TRUTH TRACK		
SLOW ROLL	0.0	0.0

	PROBE NO. 1	PROBE NO. 2
R.VOLTS&HZ	0.0	0.0
R.VOLTS&HZ	0.0	0.0

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

WESTINGHOUSE
HEAVY INDUSTRY MOTOR DIVISION
ROUND ROCK, TEXAS

CUSTOMER - INTERMOUNTAIN POWER S.O. - 1667AA-01

2100 H.P. INDUCTION MOTOR
6600 VOLTS 3 PHASE 897 RPM 60 HERTZ 8 POLES

STATOR NO. - AC1603 ROTOR NO. - AD1510

STATOR RESISTANCE TERMINAL TO TERMINAL C.149 AT 25 DEGREES C.
AIR GAP - FRONT 0.101 - REAR 0.098

PHASE ROTATION T1,T2,T3 CCW SHAFT VOLTAGE - 0.0

MAGNETIC CENTER - 3.800 FLOAT IN - 3.480 FLOAT OUT - 3.980
(MEASURED FROM SHAFT SHOULDER TO BEARING HOUSING FACE)

1 PT INPUT	6612. VOLTS	99.8 AMPS	34.6 K-WATTS	60 HERTZ
1 PT OPEN	0. VOLTS	0.0 AMPS	0.0 K-WATTS	60 HERTZ

FINAL BEARING TEMPERATURE (TOTAL)
FRONT 57.5 REAR 50.8 AMBIENT AIR 29.5

VIBRATION

	BRACKET		
	FRONT	REAR	SHAFT
HORIZONTAL	0.300 MILS	0.280 MILS	0.600 MILS
VERTICAL	0.210 MILS	0.180 MILS	0.500 MILS
AXIAL	0.380 MILS	0.200 MILS	

FINAL INSULATION RESISTANCE		INSULATION TEST FOR 1 MINUTE
STATOR	5000.00 MEGOHMS	14200. VOLTS
ROTOR	0.0 MEGOHMS	0. VOLTS
RTD'S	2600.00 MEGOHMS	1500. VOLTS
SPACE HEATER	10000.00 MEGOHMS	1200. VOLTS

BEARINGS INSPECTION COMPLETED AND APPROVED FOR SHIPMENT.

LOCKED ROTOR DATA

VOLTS			AMPERES				LB. FT.
V1-2	V2-3	V3-1	A1	A2	A3	KW	TORQUE
5724.	5748.	5784.	1248.	1240.	1220.	2256.	11050.

INRUSH & TORQUE AT RATED VOLTS - 1420 AMPERES, 14570 LB. FT.

NOTE: THE VALUE OF ZERO INDICATES:
1. IF THE MACHINE IS EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT, NO DATA WAS TAKEN.
2. THE MACHINE IS NOT EQUIPPED WITH THAT PARTICULAR DEVICE OR CIRCUIT.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS MADE AT THE HEAVY INDUSTRY MOTOR DIVISION OF WESTINGHOUSE ELECTRIC CORPORATION, ROUND ROCK, TEXAS.

SIGNED - [signature] DATE - 4-27-84
TEST ENGINEER

SIGNED - [signature] DATE - 5-2-84
DESIGN ENGINEER

NOISE TEST SHEET SHEET 1

CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984
FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	MEASURED SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	82.0	84.4	85.4	83.8	84.9	86.4	94.3	86.2
160								
200								
250	80.6	81.2	79.3	78.4	79.3	79.9	80.3	81.7
315								
400								
500	78.8	78.4	77.5	75.8	76.6	76.0	77.0	78.3
630								
800								
1K	80.3	79.6	81.5	81.0	76.0	74.9	77.9	79.8
1.3K								
1.6K								
2K	73.5	74.8	74.2	75.9	72.6	73.2	79.8	76.1
2.5K								
3.2K								
4K	70.1	69.5	67.5	67.0	65.9	65.2	65.8	67.3
5K								
6.3K								
8K	59.7	60.2	60.2	58.8	57.7	57.1	58.2	60.2
10K								
A	84.2	83.1	83.8	81.8	79.3	80.5	84.3	81.0
C	86.8	87.6	89.7	87.3	86.6	88.9	94.7	89.0
LIN	88.3	88.7	94.0	87.9	88.2	89.3	95.5	89.6

METER MAKE	TYPE	SERIAL	1/1 OCTAVE FILT. MAKE	TYPE	SERIAL	MICROPHONE MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

NOISE TEST SHEET

CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01
HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984
FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT
DESIGN ENGR - BANSAL TEST ENGR - RICHMOND

CENTER BAND FREQ	AMBIENT SOUND PRESSURE (DB) POSITIONS 1	2	3	4	5	6	7	8
100								
125	77.7	77.4	77.3	79.6	78.0	76.8	75.6	78.0
160								
200								
250	78.1	78.4	78.8	77.9	76.3	77.9	77.7	78.3
315								
400								
500	77.2	77.7	77.1	75.3	74.9	75.3	74.8	76.9
630								
800								
1K	80.3	80.6	78.4	80.6	78.8	75.1	77.4	77.9
1.3K								
1.6K								
2K	72.4	72.8	72.0	71.5	70.0	70.2	70.2	71.1
2.5K								
3.2K								
4K	67.5	68.0	67.0	66.3	64.8	64.5	64.4	66.3
5K								
6.3K								
8K	59.1	59.3	59.1	58.0	57.2	55.9	55.6	58.6
10K								
A	82.0	82.2	82.1	82.0	80.0	79.1	82.1	80.3
C	85.7	86.0	86.1	86.7	84.7	83.4	84.5	85.4
LIN	87.3	86.3	87.0	88.0	85.3	84.6	85.6	86.2

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

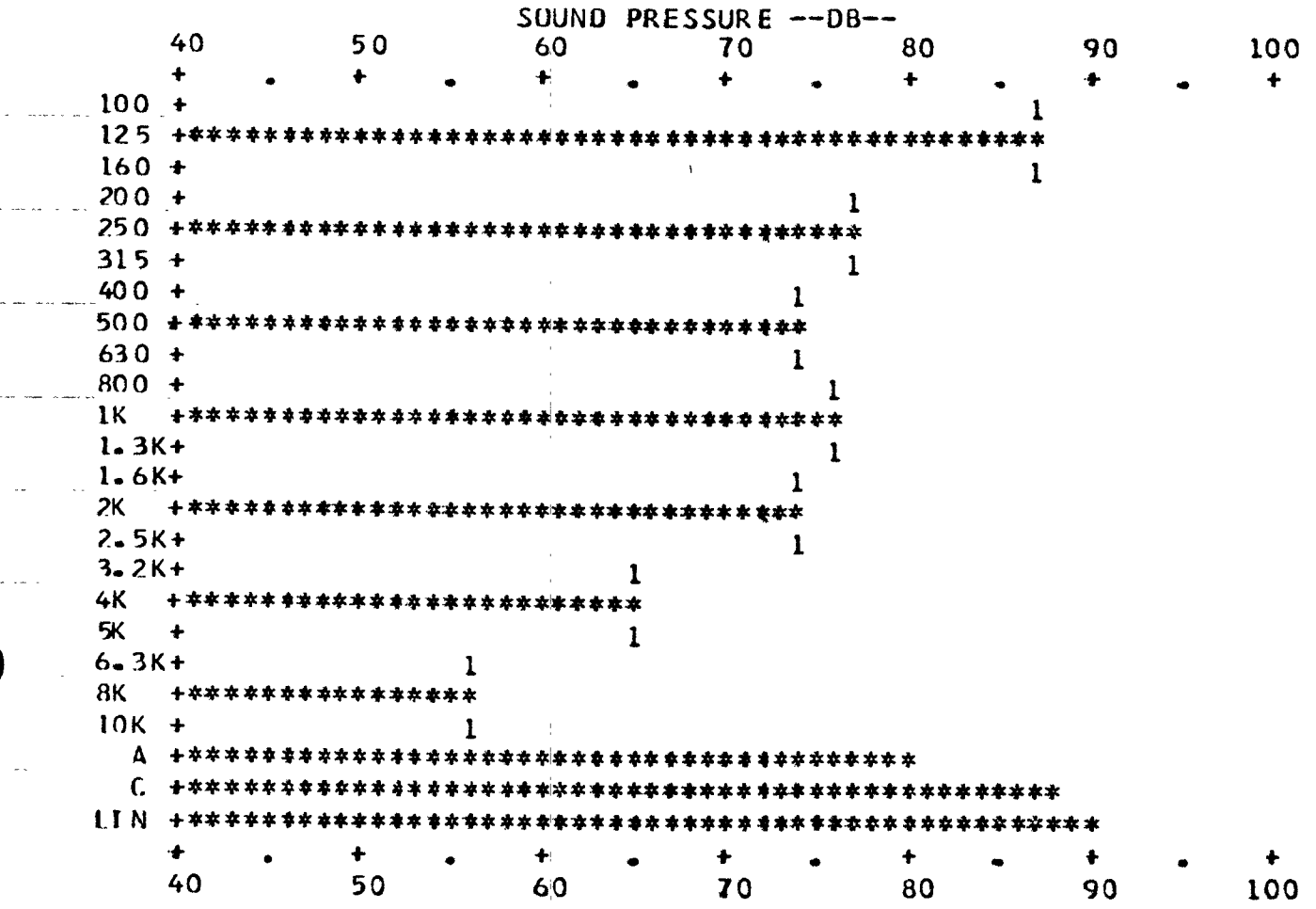
NOISE TEST SHEET SHEET 3

CUSTOMER - INTRMNT POWR SHOP ORDER NO - 1667AA-01

HP - 2100. POLES - 8. HERTZ - 60. VOLTS - 6600. DATE - APR 25 1984

FRAME - 800-1800 ENCLOSURE - WP1 MIC LOC - 3 FT

DESIGN ENGR - BANSAL TEST ENGR - RICHMOND



OCTAVE BAND LEVELS

		125	250	500	1K	2K	4K	8K	A	C	LIN
LP(3FT)	AVE	87.4	77.3	74.4	76.4	73.9	64.6	56.2	79.6	88.2	89.8
					(SUM OF OCTAVE BANDS)				80.6	88.3	88.5
LP(3FT)	MAX	94.2 (7)	79.0 (8)	75.8 (1)	78.6 (3)	79.3 (7)	67.1 (1)	57.2 (8)	81.3 (7)	94.3 (7)	95.0 (7)
LP(3FT)	MIN	80.0 (1)	75.4 (4)	72.8 (4)	71.9 (6)	69.6 (5)	62.2 (6)	54.1 (6)	76.3 (5)	83.6 (5)	84.9 (4)

METER			1/1 OCTAVE FILT.			MICROPHONE		
MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL	MAKE	TYPE	SERIAL
B&K	2210	659924	B&K	1616	765707	B&K	4165	775339

MOTOR TESTER - _____

APPRD TEST DEPT - _____

APPRD ENGR DEPT - _____

POLARIZATION INDEX DATA

CUSTOMER	SHOP ORDER	DATE
INTRMNT POWR	1667AA01	APRIL 26 1984

APPLIED VOLTS	POWER SUPPLY SERIAL NO.	TEMPERATURE (DRY BULB)	TEMPERATURE (WET BULB)	RELATIVE HUMIDITY
8250	7646	24.50	18.50	55 %

INSULATION RESISTANCE AT 24.5 DEG C

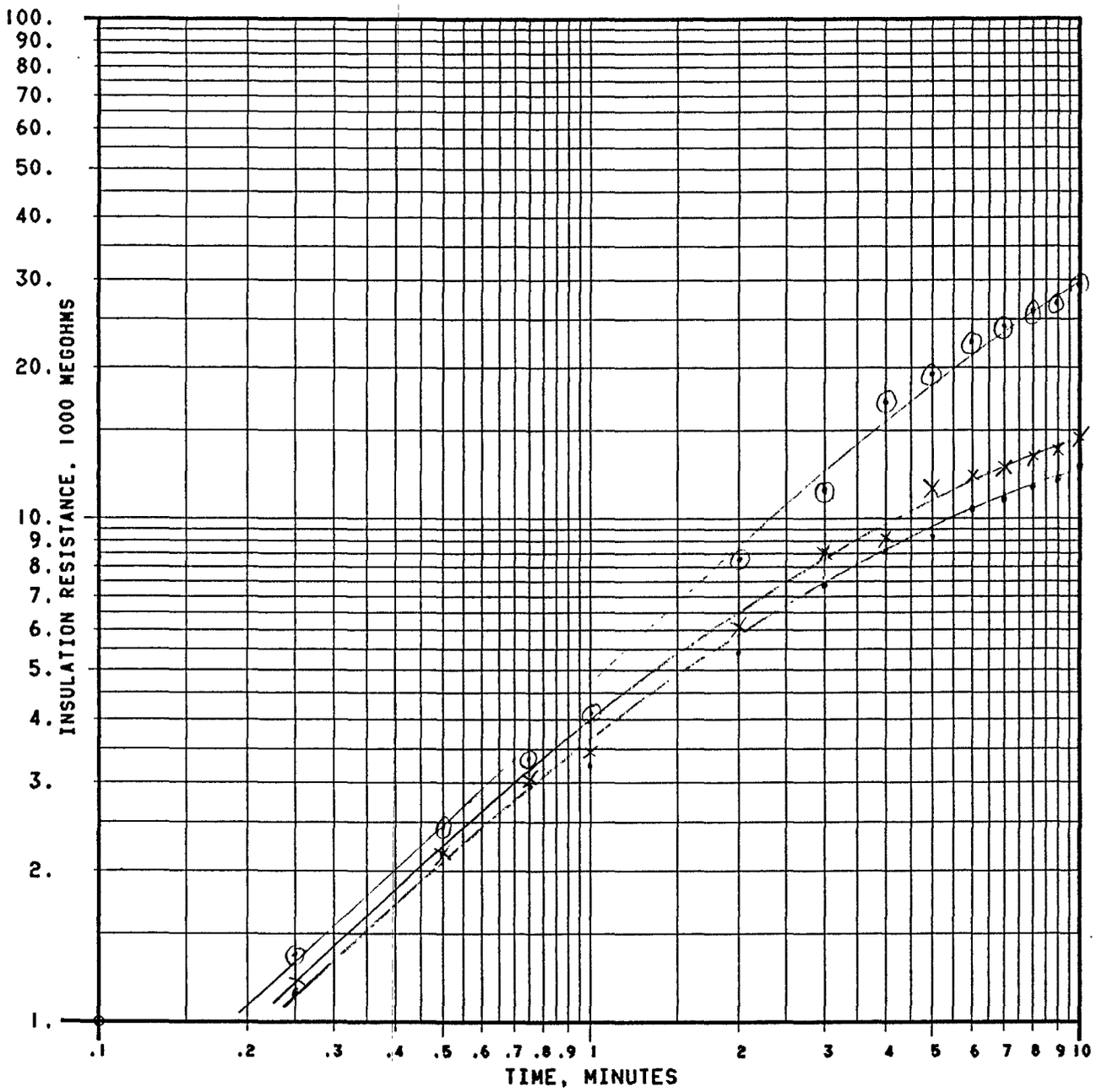
TIME	PHASE A MEGOHMS	PHASE B MEGOHMS	PHASE C MEGOHMS
15 SEC	3135	3300	3713
30 SEC	5940	5940	6683
45 SEC	8085	8250	9075
1 MIN	10065	10725	12375
2 MIN	14850	16335	22275
3 MIN	19800	23100	31350
4 MIN	23100	24750	41250
5 MIN	24750	31350	53625
6 MIN	28050	33000	61875
7 MIN	29700	34650	66000
8 MIN	31350	36300	70125
9 MIN	33000	37950	74250
10 MIN	34650	39600	78375

INSULATION RESISTANCE CORRECTED TO 40 DEG C

	PHASE A	PHASE B	PHASE C
15 SEC	1160	1221	1374
30 SEC	2198	2198	2473
45 SEC	2991	3052	3358
1 MIN	3724	3968	4579
2 MIN	5494	6044	8242
3 MIN	7326	8547	11599
4 MIN	8547	9157	15262
5 MIN	9157	11599	19841
6 MIN	10378	12210	22894
7 MIN	10989	12820	24420
8 MIN	11599	13431	25946
9 MIN	12210	14041	27472
10 MIN	12820	14652	28999

POLARIZATION INDEX

PHASE	A	B	C
	3.44	3.69	6.33



· CURVE "A" - PHASE "A" PI = 3.4
× CURVE "B" - PHASE "B" PI = 3.7
⊙ CURVE "C" - PHASE "C" PI = 6.3

40°C INSULATION RESISTANCE
S.O. 1667AA-01

Donald E Richmond 4-26-84

IP12_001887

TELEDOCY
****

WESTINGHOUSE ELECTRIC CORPORATION
REPAIR SERVICES DIVISION
Heavy Industrial Motor Parts Support Center
I-H 35 North & Westinghouse Road
Round Rock, Texas 78681

TO: John Christianson DATE: 9/14/90

TELECOPIER NO: 801-8.4-4970

FROM: Duane Mc Eachron

NUMBER OF PAGES (Including this sheet) 1

Please call the following number to verify message received or if any problems occur during transmission:
(512) 388-0116 or
(WIN) 641-0116.

Our FAX number: (512) 388-0320 or
(WIN) 641-0320

NOTE:

Reference: PAM motors S.O. 1667AA and 1668AA minor overload operation

These motors can be operated at 10 to 15 amperes above nameplate rating on either speed without affecting the motor adversely. There is sufficient mechanical and thermal margin to accommodate these small increases in load on a continuous basis.

There appears to be significant thermal margin on these machines but we would have to perform a study to determine the maximum horsepower capability on the machines. There is a short term problem with design program access now but the problem should clear shortly and we will be able to quote a study.

2 1

GEN RAL NOTES

IFACTURER'S WARR NTY ON THIS EQUIPMENT TO BE IN
EQUIPMENT MUST LE INSTALLED IN STRICT ACCORDANCE
AWING AND THE I STRUCTION BOOK.

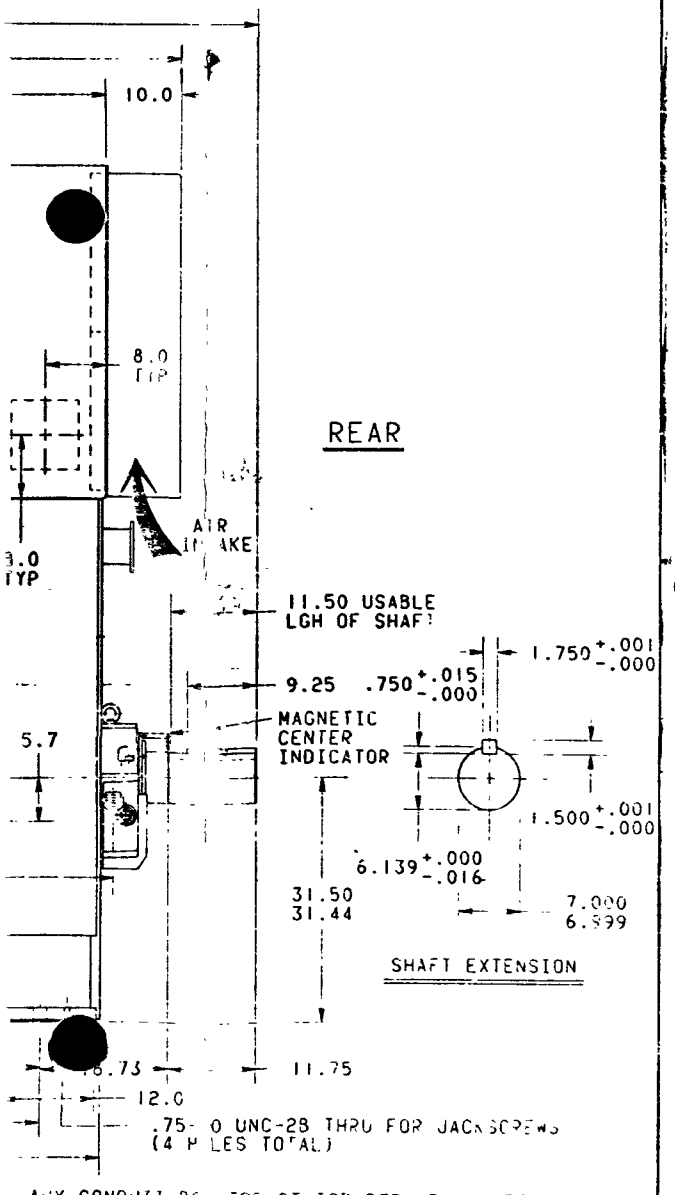
HEAVY INDUSTRY MOTOR DIVISION DOES NOT HAVE
TY FOR LATERAL AND TORSIONAL CRITICAL SPEED
OF THE INSTALLATION. MOTOR DATA NECESSARY TO
STUDIES WILL BE FURNISHED ON REQUEST.

HEAVY INDUSTRY MOTOR DIVISION IS NOT RESPONSIBLE
ON DESIGN. MOTO WEIGHTS ARE SHOWN AND
REACTIONS NECES RY FOR FOUNDATION DESIGN ARE
THIS DRAWING.

DPLAY IS 0.5 IN TOTAL. A LIMITED END FLOAT TYPE
REQUIRED TO LIM ENDPLAY TO 0.19 INCH.

PPLIED BY WESTINGHOUSE HEAVY INDUSTRY MOTOR
UNDATION BOLTS, LIFTING BEAMS, SLINGS, SPREADER
ATING OILS, COUPLINGS AND COUPLING GUARDS,
AND DOWELS.

NOT DESIGNED TO TAKE ENDTHRUST.



WESTINGHOUSE ELECTRIC CORPORATION

TRANSMITTAL DATE: 5-23-84

336618DH/336639DH	CL30900/CL30901	1667AA/1668AA
Customer Order No.	General Order No.	Shop Order No.

Customer:
Babcock and Wilcox

Intermountain Power Project
Lynda1 Utah
Project File 9255.62.3401; Spec. 2013
Steam Generator Unit 1 & 2
B & W Contract No. 334-061[illegible]
B & W P.O. 336601/336622

☐ FOR APPROVAL, TO MAINTAIN SHIPPING SCHEDULE, APPROVED DWGS., MUST BE RECEIVED BY WESTINGHOUSE ON_____. Drawings are in compliance with your specified requirements. Drawings "approved" or "approved with modifications" authorize Westinghouse to proceed with the manufacture, modifications not in the contract or modifications made during or after drawing approval may result in a price change and/or shipment delay.

☒ FOR CONSTRUCTION OR INSTALLATION The equipment shown on these drawing(s) has been released for manufacture, any modification may result in price change or shipment delay.

☒ FINAL
Spd. Approval by:
-

▲ = Revised Since Previous Issue

Send approvals or inquiries to the Westinghouse office with whom the order is placed.
These prints supersede prints previously provided.

DRAWINGS		
Outline	1897F83	REV 06
Motor Connection	7903A32	REV 02
Stator RTD	7903A02	REV 01
Diff. Press. Sw.	7903A99	REV 01
Tach./Speed Sw.	7903A08	REV 01
▲ Brg. TC's	7903A36	REV 02
PAM Switching	7903A39	REV 01
Motor Space Heaters	8627A58	REV 01
Soleplate Details	8631A56	REV 05
Grouting Details	8631A32	REV 02

Differential CT Ratio	50:1
Motor Htr. Rating	120/240V-10.9/5.5 Amps 1 Phase
Stator RTD Type	10 OHM, Copper
Brg. TC Type	Chromel-Const.

DATA		
Efficiency (Calculated)	4/4 Load	96.3/95.8
	3/4 Load	96.2/95.5
	1/2 Load	95.5/94.3
Power Factor (Calculated)	4/4 Load	88.5/77
	3/4 Load	86/70
	1/2 Load	80/57

DATA (Calculated)	
Frame Size	800-1800S70
Motor Type	LLD-CS-PAM
Enclosure	DP
Horsepower	4000/2100
Voltage	4600
Full Load Amps	303/163
Hertz	60
Phase	3
Service Factor	1.0
Application	Primary Air Fan
Ld Torque Curve	7-7-81-2-Vanes Closed
Load WK^2 LB-FT^2	152185
Motor WK^2 LB-FT^2	9410
Poles	6/8
RPM	1195/897
Rotation	Bi Rotational
Insul. Class	B
Ambient Temp. °C	40
Altitude Ft.	4700
Temp. Rise °C	80°C
L.R. Amps	645%/736%
Starting Torque	88%/106%
Breakdown/Pull-Out Torque	252%/321%
Accel. Time (100% Volts)	40.3/33.7 secs.
Sound Level	87 dBA at 3 ft.avg
Safe Locked Time (85% V)	58.7/92.4
Accel. Time (85% Volts)	69.0/55.8 secs.

Customer Motor Tag Numbers
XSGB - MFAN - 2A
XSGB - MFAN - 2B
Where X is the associated Units Numbers 1 and 2

RECOMMENDED INSTRUMENT SETTING DATA

Stator RTD	ALARM	130°C	TRIP	135°C
Brg. Metal TC	ALARM	85°C	TRIP	95°C
Diff. Pressure Switch		.35 inch water		

NOTES FOR DATA SHEET

1. Front bearing is insulated. Any metal connection to it must be insulated from it.
2. Use a good quality of rust and oxidation inhibited turbine oil with a viscosity of approximately 180-220 SSU at 100°F. Viscosity index should not be less than 95.
3. Front Bearing Size 5.5 x 4.1 Oil Capacity 2.2 Gal
   Rear Bearing-Drive End Size 5.5 x 4.1 Oil Capacity 2.2 Gal
4. The time delay between speed changes must be at least 3 seconds.
5. Motor is shipped assembled with main lead box removed.
6. Motor to be shipped with customer's half-coupling installed.
7. Measure the airgap at 4 places 90° apart. Variation of the minimum and maximum airgap from the average of these values must not be greater than ± 10 %.
8. Air intake filters are American Air Filter disposable fibre glass type To service these filters, remove intake turn boxes, and replace disposable pads.
9. Foundation Reactions -- pounds per bolt at center-line of hold-down bolt holes:
   Static X = Motor Weight/ 4
   Rated Motor Torque X = Motor Weight/ 4 ± 1580
   Maximum Motor Torque X = Motor Weight/ 4 ± 12600
10. With rated voltage and frequency (within NEMA limits) at motor terminals and with connected load inertia not exceeding 152185 lb-ft² the following starting duty should not be exceeded:
    Motor cold 1/2 consecutive starts
    Motor at operating temperature 1/1 consecutive start,
    Subsequent starts with motor running between starts
    20 minutes apart or with motor standing between starts
    45 minutes apart
    Note: The number of starts, The [illegible] for [illegible]
    [illegible] with [illegible] for [illegible] Review [illegible] ty.
11. Install & [illegible] g[illegible] support along their full length and foundation bolts fully [illegible]ed [illegible]lace[illegible] the level and in one plane.

Westinghouse
Electric Corporation

Heavy Industry Motor Parts Support
Center

Box 185
Round Rock Texas 78680-0185
(512) 388 0116

September 14, 1990

Intermountain Power Service Corp.
Route 1, Box 864
Delta, Utah 84624
Attn: John Christianson

Reference: PAM motors S.O. 1667AA and 1668AA minor overload operation

Dear Mr. Christianson,

These motors can be operated at 10 to 15 amperes above nameplate rating on either speed without affecting the motor adversely. There is sufficient mechanical and thermal margin to accommodate these small increases in load on a continuous basis.

There appears to be significant thermal margin on these machines but we would have to perform a study to determine the maximum horsepower capability on the machines. There is a short term problem with design program access now but the problem should clear shortly and we will be able to quote a study.

Regards,

Duane McEachron

DM:jh
HIMSC370

[//] REQUISITION FOR CAPITAL EQUIPMENT

[XX] PURCHASE AUTHORIZATION FOR EXPENSE ITEMS

Date January 22, 1992
Req./PA No // 66506
P.O. No
Vendor
Terms
FOB
Ship Via
Conf. To:

Purpose of Materials, Supplies or Services: To determine the maximum loading capability of the existing PA Fan Motors.

Suggested Vendor Westinghouse Motor Company
PO Box 277
Round Rock, Texas 78680-0277

Account No.

Work Order No. 91-97827-00

Qty	Unit	Description Noun Adjective Catalog #	Seller or Manufacturer	Unit Cost	Extension
1	lot	Perform analysis of the design of the PA Fan Motors provided under		5300	$5300
		Westinghouse shop order numbers 1667AA/1668AA to determine the maximum			
		loading capability. Load capability shall be based on a maximum 80 C			
		rise with the motor operating at 4700 ft and a 40 C ambient. Maximum			
		loading shall be given in horsepower for both speeds. Analysis shall			
		include all revisions to nameplate information. Expected performance			
		including efficiency and power factor shall be given at no load, 25%			
		load, 50% load, and 100 % load. Maximum capability shall be based on			
		current IEEE, ANSI and NEMA standards. Four copies of the report shall			
		be provided. Provide test reports from electrically identical motors.			
		TOTAL ESTIMATED COST			$5300

Remarks: //

Delivery requested by [Date] FEB 21,1992

Originator Jon P. Christensen JPC

Dept. Mgr/Supt. Date

Station Manager Date

Operating Agent Date

INTERMOUNTAIN POWER SERVICE CORPORATION

Form IPSC 9A

FAXED DESCRIPTION ONLY TO MARK LIDELL 1/22/92

IP12_001891

Westinghouse
Motor Company .....*THE Preferred Source*

218-7148

Mark Lidell
After Market Sales Specialist

P.O. Box 277
Round Rock, TX 78680-0277

(512) 255-4141, Ext. 248
WIN 622-7248
FAX 512-244-5500/5512

Quick Service Quotation

TO INTERMOUNTAIN LOCK

Your Inquiry No. Verbal 5-22-91

>>> Attn. . John Christensen Pages 1

Our Neg. No. 05239/mc01

Phone (801) 864-4414 Fax 4970

Shop Order No. 1667AA/1668AA

Confirming verbal quotation to _____ Date _____

Ultimate Customer (if resale) _____

Dear Sir,
We are pleased to confirm the verbal quotation made on the above date as follows:

ITEM	QTY.	PRODUCT DESCRIPTION	PRICE EA.	TOTAL $	DELIVERY
1	1	STUDY To Determine MAX HP	$ 3380	$ 3380	2-4 WK
		CAPACITY OF MOTOR			
		S.O. # 1667AA & 1668AA			
—	—	Please FAX ME A MORE			
		Defined Scope OF WORK			
		IF You Decide To Place			
		AN ORDER			

OFFICE After Market Sales

SIGNATURE Mark Lidell

NOTES
(1) Quotation expires in 30 Days or on notice.
(2) Shipment quoted is based on receipt of complete information at the factory.
(3) Stock shipments are quoted subject to prior sale
(4) Subject to the terms and conditions WMC Selling Policy 100.
(5) Terms net 30 from date of invoice.
(6) Delivery is F.O.B. Shipping Point- FRT/Ppd. and not allowed (billed as actual)

Westinghouse
Motor Company . . . . . *THE Preferred Source*

Quick Service Quotation

Mark Lidell
After Market Sales Specialist
Renewal Parts & Services

IH-35 & Westinghouse Rd. (512) 218-7248
P.O. Box 277 (78680-0277) WIN 622-7248
Round Rock, TX 78681 FAX 512-244-5500/5512

TO INTERMOUNTAIN PWR.

Your Inquiry No. Fax 1-22-92

>>> **Attn.** Jon Christensen **Pages** 1 **Our Neg. No.** 012392 mL07

Phone (801) 864-4414 **Fax** 4970 **Shop Order No.** 1667AA/1668AA

Confirming verbal quotation to _____ **Date** _____

Ultimate Customer (if resale) _____

Dear Sir,
We are pleased to confirm the verbal quotation made on the above date as follows:

ITEM	QTY.	PRODUCT DESCRIPTION	PRICE EA.	TOTAL $	DELIVERY
1	1	Design Analysis Of The PA	5240 00	5240 00	3 Weeks
		fan Motors To Determine MAX.			
		H.P. At Low & High Speed.			
		Using ORIGINAL Load Curves			
		WK^2.			

OFFICE After Market Sales **SIGNATURE** Mark Lidell

NOTES
(1) Quotation expires in 30 Days or on notice.
(2) Shipment quoted is based on receipt of complete information at the factory.
(3) Stock shipments are quoted subject to prior sale
(4) Subject to the terms and conditions WMC Selling Policy 100.
(5) Terms net 30 from date of invoice.
(6) Delivery is F.O.B. Shipping Point- FRT/Ppd. and not allowed (billed as actual)

MOTOR DATA

Customer: INTERMOUNTAIN POWER SERVICE CORP.

Apparatus: PAM INDUCTION MOTOR

Date Prepared: 02-26-98

Customer's Purchase Order: 92-52591

Westinghouse General Order: XH20246

Westinghouse Motor Co. Shop Order 25155AA

WMC
Westinghouse
Motor Company

Post Office Box 277
Round Rock, Texas 78680-0277

WESTINGHOUSE MOTOR COMPANY
ROUND ROCK, TEXAS

WMC ENGINEERING REPORT
WMC-EER-92-002

DATE: February 25, 1992

SUBJECT: Study to determine the maximum loading capability of the machines supplied earlier on S.O. 1667AA-1668AA without exceeding temperature rise up to ANSI/NEMA Class B.

DISTRIBUTION: J. M. Lidell
R. J. Connolly

ABSTRACT: It has been found that the machines can be uprated from 4000/2100HP 6/8 poles, PAM, 1.0 service factor to 5000/3200HP, 6/8 poles, PAM, 1.15 service factor and can operate without exceeding the ANSI/NEMA Class B temperature rise limits.

APPROVED: J. Conomos 2/26/92 BY: S. P. Bansal
J. J. Conomos
Manager
Induction Engineering

S. P. Bansal
Advanced Design Engineer

APPROVED: 2/26/92 BY: D. F. Kosar
M. K. Wen
Manager
Advance Design &
Development Engineering

D. F. Kosar
Staff Engineer

OBJECTIVE:

The purpose of the study was to determine the maximum loading capability within ANSI/NEMA Standard requirements of Westinghouse Motors supplied under shop order 1667AA and 1668AA.

DESCRIPTION OF EXISTING MOTORS

4000/2100 HP, 6600V, 3 PH, 60 HZ, 1195/897 RPM, WP-I enclosure, 1.0 service factor, 80°C rise (by resistance). Frame size 8018, horizontal induction motor.

Rated Amps	303/186	Efficiency	
Starting torque	89/106%	Full Load	96.32/95.82%
Pull out torque	252/321%	3/4 Load	96.36/95.52%
Inrush	1953/1352 Amps (643/728%)	1/2 Load	95.63/94.48%

Power Factor:

F.L. 89.2/76.9%
3/4 Load: 87.9/70.5%
1/2 Load 82.8/58.4%2

Machine was designed for 85% reduced voltage start, unloaded start per Curve # 7-7-81-2 (Revision 2) and driven equipment load inertia 152185 LB-FT^2.

LOADING CAPABILITY

The machine can be operated at 5000/3200 HP at 6 and 8 pole respectively at 1.15 service factor without exceeding the NEMA Class B temperature rise limits.

Expected temperature rise at 5000 HP, 6P speed at 1.0 service factor is 70°C and at 3200 HP, 8P speed at 1.0 service factor 46°C (by resistance) at an altitude of 4700 ft. For this study it is assumed that machine will be started unloaded per the earlier load curve #7-7-81-2 (Revision 2) and driven equipment load inertia is 152185 LB-ft^2.

Performance data at both the speeds, which includes the nameplate information is attached. Speed-torque curves and thermal limit curves at rated voltage and at 90%, 85% reduced voltage start are attached.

MECHANICAL CONSIDERATION

Many factors are taken into consideration when making a mechanical design integrity evaluation of electric motors. The basis of this study is the upgrading from 4000 HP to 5000 HP, 1.15 service factor, which is a torque function. Therefore, only those features of the motors that are torque related or dependent have been analyzed. The value of torque that was used in the calculations was the highest anticipated torque at any of the operating conditions.

The torque that is developed in the airgap is transmitted to the foundation through the stator core and to the driven equipment through the rotor core and shaft. The following were analyzed:

- Foundation Reactions
- Stator Core-to-Frame Attachment
- Rotor Core-to-Shaft Attachment
- Shaft Fabrication Stresses
- Bearing Journal Shear Stress
- Shaft Extension Stresses

The new foundation reactions are given below.

Foundation Reactions per Bolt

Rated Torque	Motor Weight/4	+/- 2,270
Maximum Torque	Motor Weight/4	+/- 18,000

CONCLUSION

Temperature rise of stator winding when motor is operating at 5000/3200 HP, S.F. 1.00 is still expected to be within class B. Since rise is within class B, the thermal life of the insulation will not be reduced compared to designed (nameplate) life at 80°C rise. Motor can be operated at 1.15 service factor with temperature rise limits per ANSI.

The calculated stresses in the locations given above have been judged acceptable for the new horsepower rating.

The foundation should be reviewed for the additional loading created by the increase in horsepower.

DISCLAIMER

The conclusion of this study is not to be interpreted in any way to include warranties or assumption of any responsibilities or liabilities.

WESTINGHOUSE MOTOR COMPANY

ROUND ROCK, TEXAS U.S.A.

CUSTOMER INTERMOUNTAIN POWER
CUSTOMER ORDER NO.
APPLICATION FAN
S.O. 25155AA

DATE - FEB 25,92

G.O. XH20246

DATA FOR WORLD SERIES, HORIZONTAL, BRACKET TYPE INDUCTION MOTOR

1. RATING

HP	5000	HERTZ	60	INSUL CLASS	F
RPM FL	1193	SERVICE FACTOR	1.15	KVA CODE	D
VOLTS	6600	RISE C (1.00 SF)	80	DUTY	CONTINUOUS
AMPS FL	380	METHOD	RES		
PHASES	3	AMBIENT C	40		

CABLE 442

2. MECHANICAL

FRAME	8018	BRG TYPE	SLEEVE	END PLAY INCH	0.50
ENCL TYPE	**WP-1**	LUBE TYPE	**SELF**	MOTOR WK SQ	9576
ROTATION (ODE)	BI	NO. BRGS	2	LOAD WK SQ	152185
STATOR WT LBS	*	ROTOR WT LBS	*	TOTAL WT LBS	*
SHAFT EXTENSION	**S70**				

*** Per outline drg 1897F83**

3. STARTING PERFORMANCE - NOMINAL, VALUES WITH (*) ARE GUARANTEED

		100% VOLTS		90% VOLTS	85% VOLTS
TEMPERATURE		75C	40C	40C	40C
AMPS (LR)		1946	1953	1724	1612
AMPS (LR)	%	512	513	453	424
POWER FACTOR	%	16.4	15.9	15.6	15.4
START TORQUE	%	72	71	55	48
PULL-UP TORQUE	%	72	71	55	48
ACCELERATION SEC			40.4	56.7	69.5
SAFE LOCK	SEC	FROM HOT	40.5	51.8	59.3

AT 100% VOLTS:
PULLOUT TORQUE % = 202

4. EFFICIENCY - NOMINAL

LOAD	%	115	100	75	50	25
EFFICIENCY	%	96.11	96.33	96.49	96.16	94.08

5. POWER FACTOR - NOMINAL

LOAD	%	115	100	75	50	25	NO Load
POWER FACTOR	%	83.2	89.1	89.1	86.1	71.8	5.4

MAX KVAR = 707 MAX FL P.F. = 85.0

IP12_001898

WESTINGHOUSE MOTOR COMPANY

ROUND ROCK, TEXAS U.S.A.

CUSTOMER INTERMOUNTAIN POWER
CUSTOMER ORDER NO.
APPLICATION FAN
S.O.25155AA

DATE - FEB 25,92

S.O. XH20246

DATA FOR WORLD SERIES, HORIZONTAL, BRACKET TYPE INDUCTION MOTOR

1. RATING

HP	3200	HERTZ	60	INSUL CLASS	F
RPM FL	395	SERVICE FACTOR	1.15	KVA CODE	E
VOLTS	6600	RISE C (1.00 SF)	80	DUTY	CONTINUOUS
AMPS FL	265	METHOD	RES		
PHASES	3	AMBIENT C	40		

2. MECHANICAL

FRAME	8018	BRG TYPE	SLEEVE	END PLAY INCH	0.50
ENCL TYPE	WP-1	LUBE TYPE	SELF	MOTOR WK SQ	9576
ROTATION (ODE)	BI	NO. BRGS	2	LOAD WK SQ	152185
STATOR WT LBS	*	ROTOR WT LBS	*	TOTAL WT LBS	*
SHAFT EXTENSION	S70				

*** Per outline drg 1897F83**

3. STARTING PERFORMANCE - NOMINAL, VALUES WITH (*) ARE GUARANTEED

		100% VOLTS		90% VOLTS	85% VOLTS
TEMPERATURE		75C	40C	40C	40C
AMPS (LR)		1348	1352	1193	1115
AMPS (LR)	%	509	511	451	422
POWER FACTOR	%	15.1	14.7	14.4	14.2
START TORQUE	%	71	70	55	48
PULL-UP TORQUE	%	71	70	55	48
ACCELERATION SEC			33.6	46.0	55.6
SAFE LOCK	SEC	FROM HOT	63.7	81.2	93.0

AT 100% VOLTS:
PULLOUT TORQUE % = 211

4. EFFICIENCY - NOMINAL

LOAD	%	115	100	75	50	25
EFFICIENCY	%	96.13	96.30	96.36	95.89	93.49

5. POWER FACTOR - NOMINAL

LOAD	%	115	100	75	50	25	No Load
POWER FACTOR	%	82.2	81.9	79.1	70.9	49.3	3.5

MAX KVAR = 359 MAX FL P.F. = 84.4 %

IP12_001899

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 100% LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL

NEG 25155AA

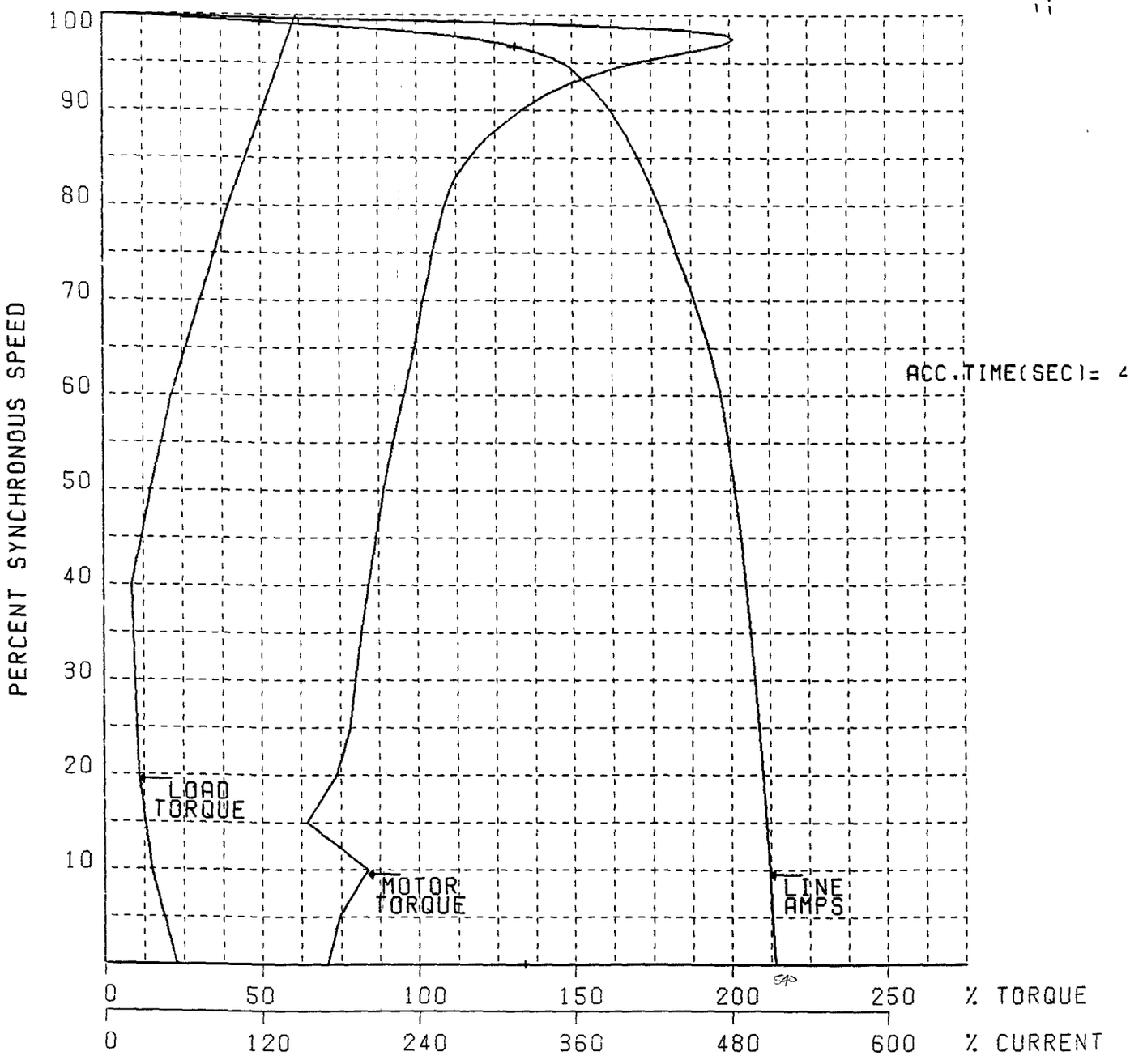
HP 5000 VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1193

PF 0.89 FL AMPS 380 LOCK AMPS(%) 514 RPM (SYN) 1200

FL TORQUE(LB-FT) 22023 LOCK TORQUE(%) 71

LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018

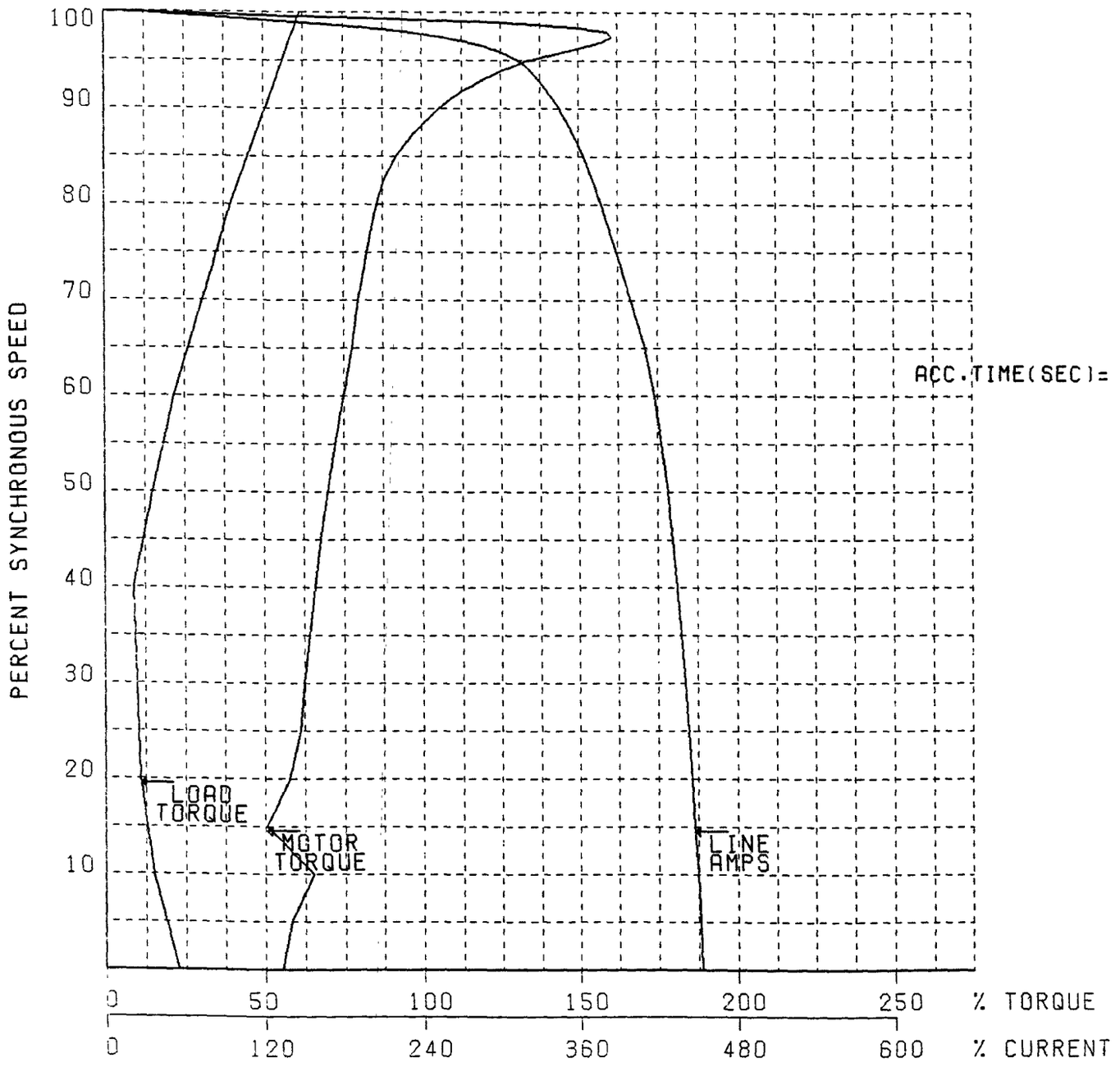
LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 90 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL
NEG 25155AA
HP 5000 VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1193
PF 0.89 FL AMPS 380 LOCK AMPS(%) 454 RPM (SYN) 1200
FL TORQUE(LB-FT) 22023 LOCK TORQUE(%) 55
LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018
LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 85 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL

NEG 25155AA

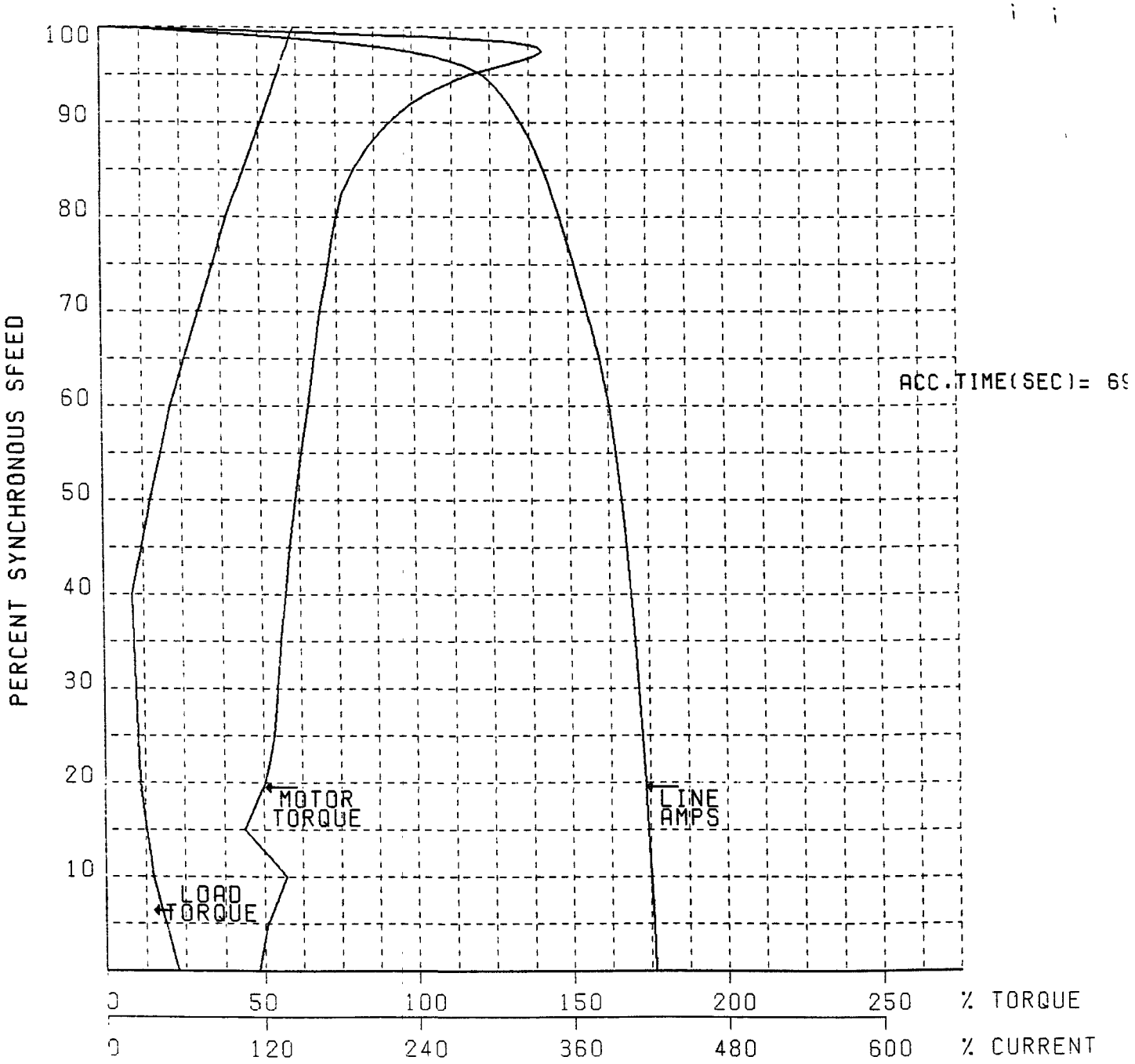
HP 5000 VOLTS 6600 PH 3 HZ 60 POLES 6 RPM (FL) 1193

PF 0.89 FL AMPS 380 LOCK AMPS(%) 424 RPM (SYN) 1200

FL TORQUE(LB-FT) 22023 LOCK TORQUE(%) 48

LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018

LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN

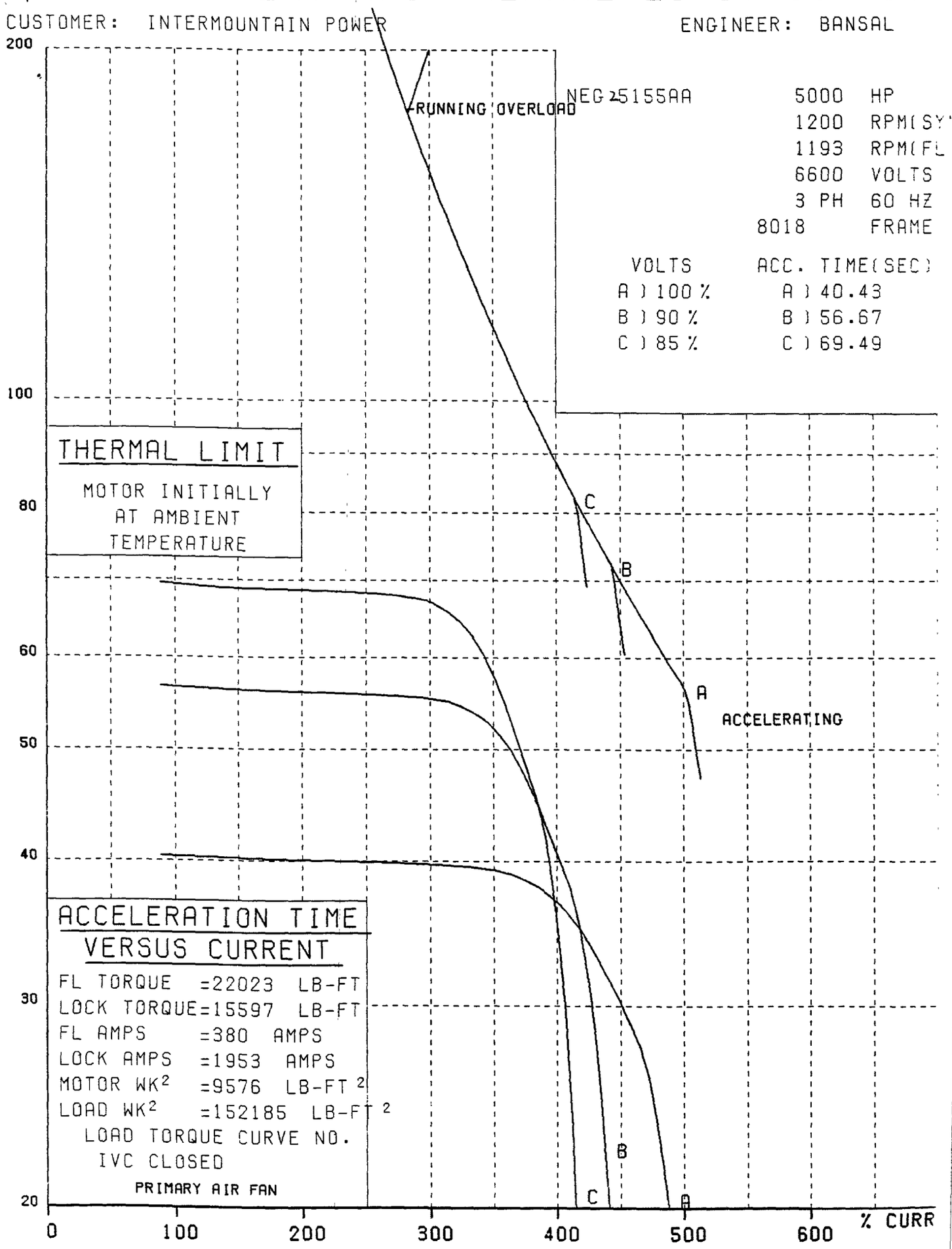


WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: BANSAL



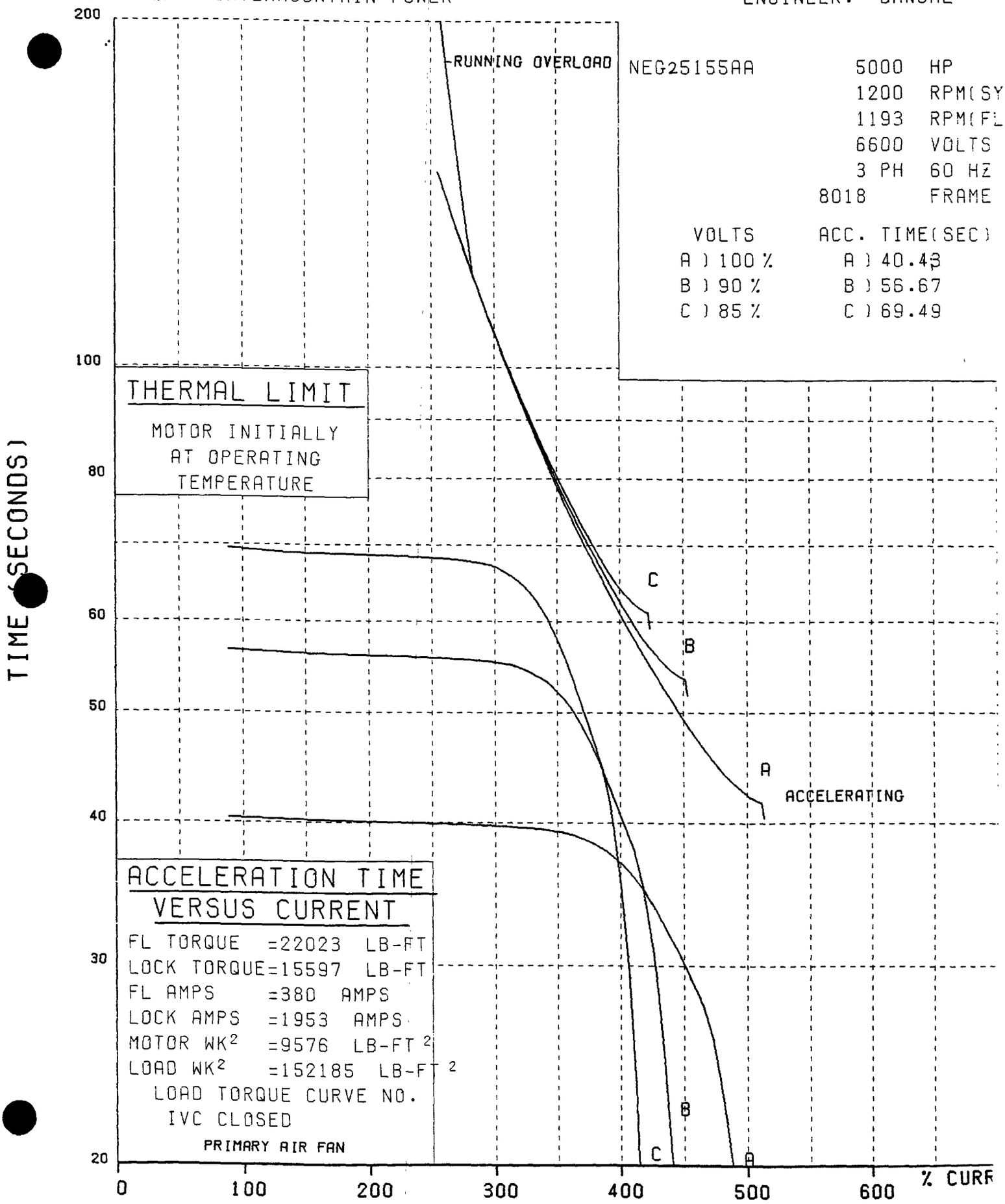
WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

IP12_001903

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: BANSAL



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

IP12_001904

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 100% LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL

NEG 25155AA

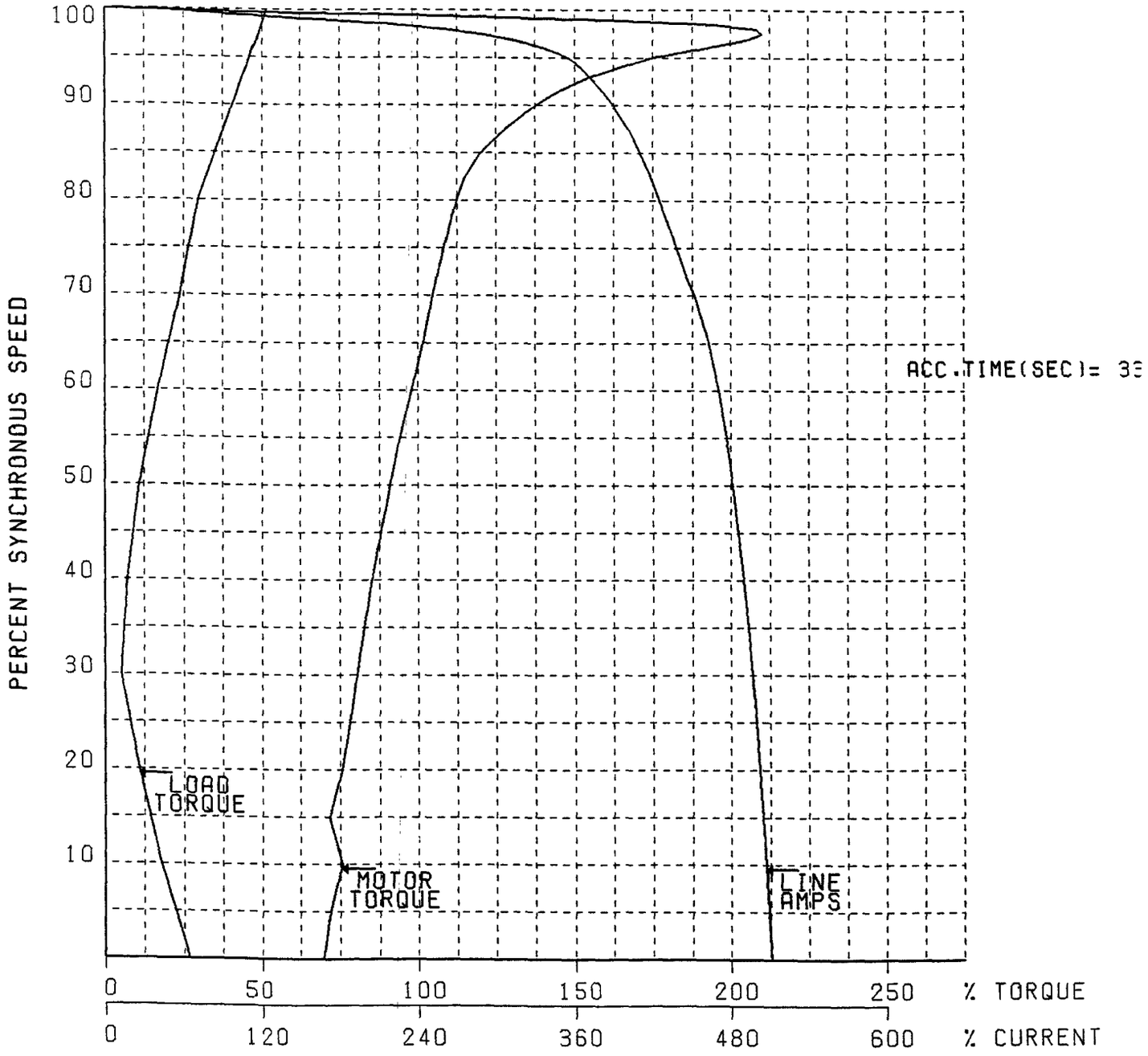
HP 3200 VOLTS 6600 PH 3 HZ 60 POLES 8 RPM (FL) 895

PF 0.82 FL AMPS 265 LOCK AMPS(%) 510 RPM (SYN) 900

FL TORQUE(LB-FT) 18764 LOCK TORQUE(%) 70

LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018

LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

CURVE NO. SPB0004

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 90 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL

NEG 25155AA

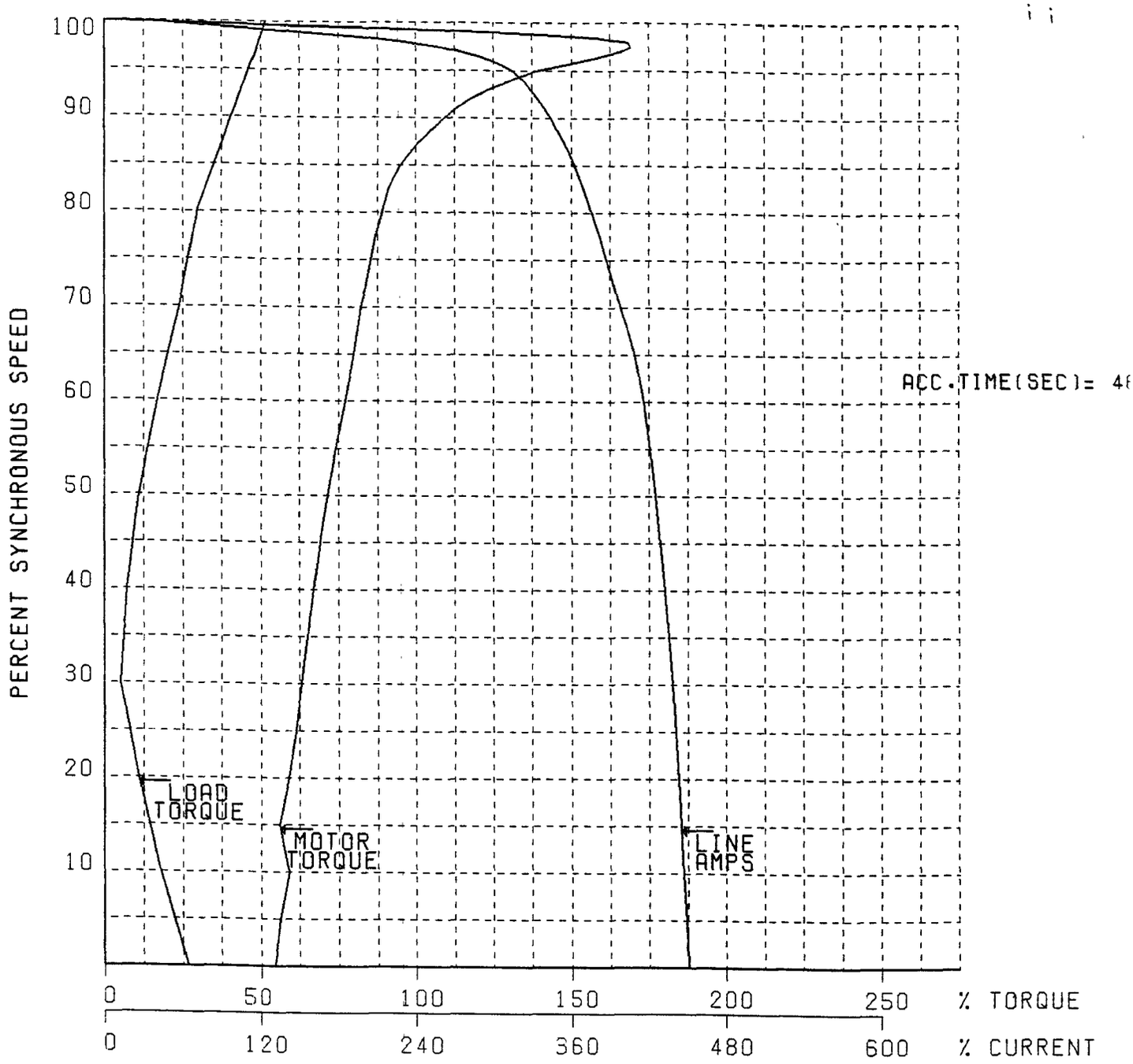
HP 3200 VOLTS 6600 PH 3 HZ 60 POLES 8 RPM (FL) 895

PF 0.82 FL AMPS 265 LOCK AMPS(%) 450 RPM (SYN) 900

FL TORQUE(LB-FT) 18764 LOCK TORQUE(%) 55

LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018

LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

IP12_001906

INDUCTION MOTOR STARTING CHARACTERISTICS
(CALCULATED) AT 85 % LINE VOLTAGE

CUSTOMER INTERMOUNTAIN POWER ENGINEER BANSAL

NEG 25155AA

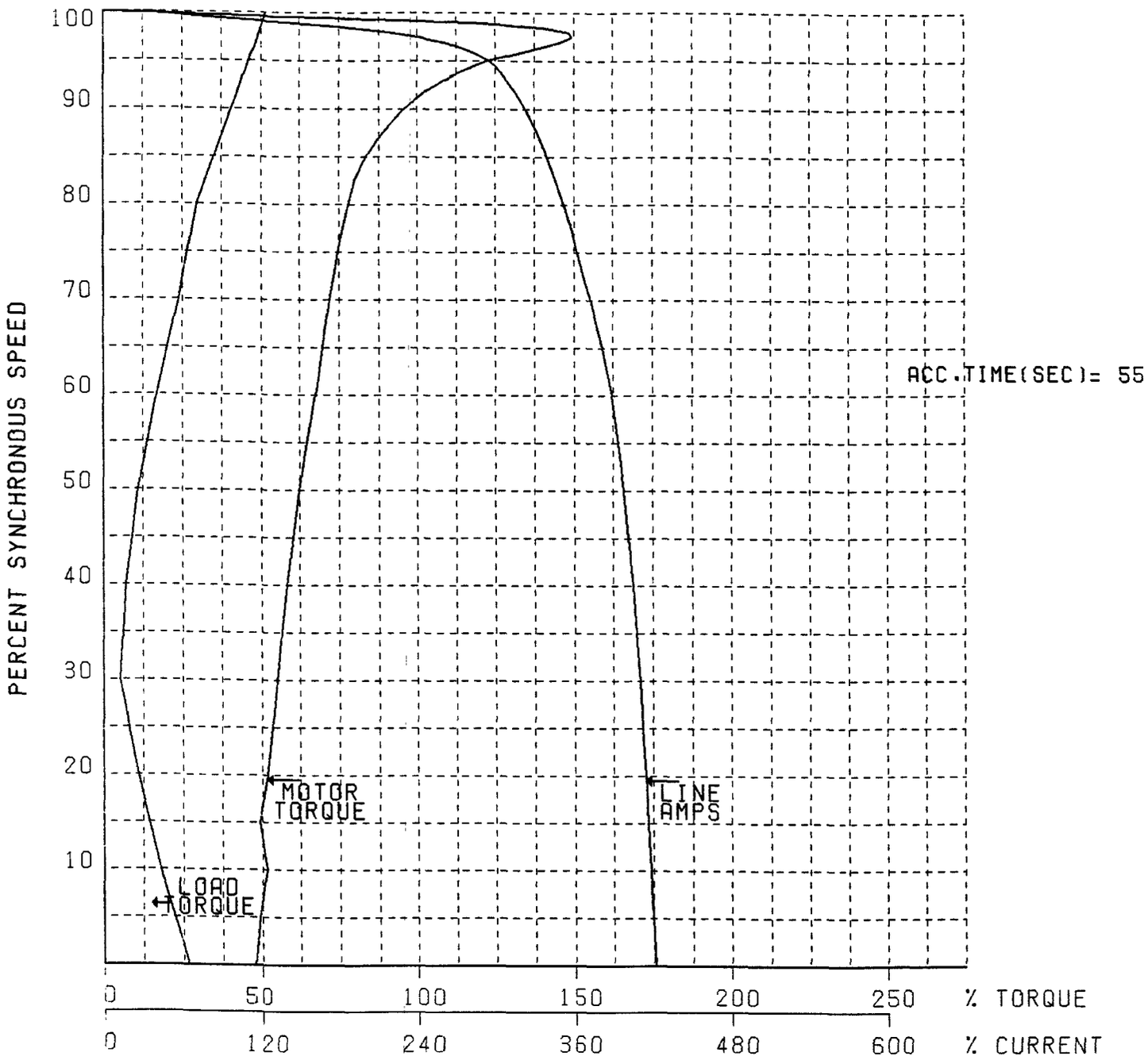
HP 3200 VOLTS 6600 PH 3 HZ 60 POLES 8 RPM (FL) 895

PF 0.82 FL AMPS 265 LOCK AMPS(%) 421 RPM (SYN) 900

FL TORQUE(LB-FT) 18764 LOCK TORQUE(%) 48

LOAD WK²(LB-FT²) 152185 MOTOR WK²(LB-FT²) 9576 FRAME 8018

LOAD CURVE IVC CLOSED APPLICATION PRIMARY AIR FAN

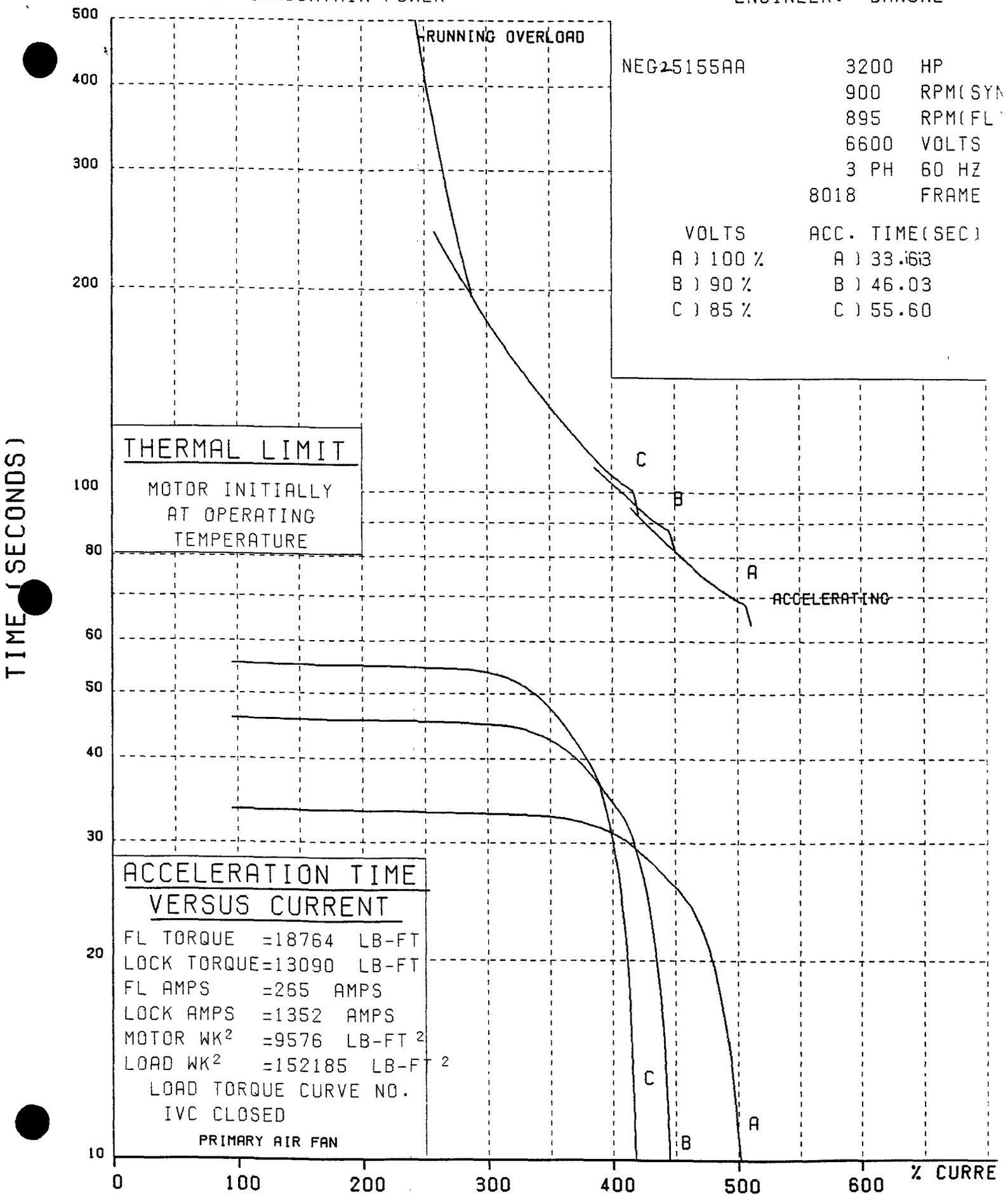


WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: BANSAL



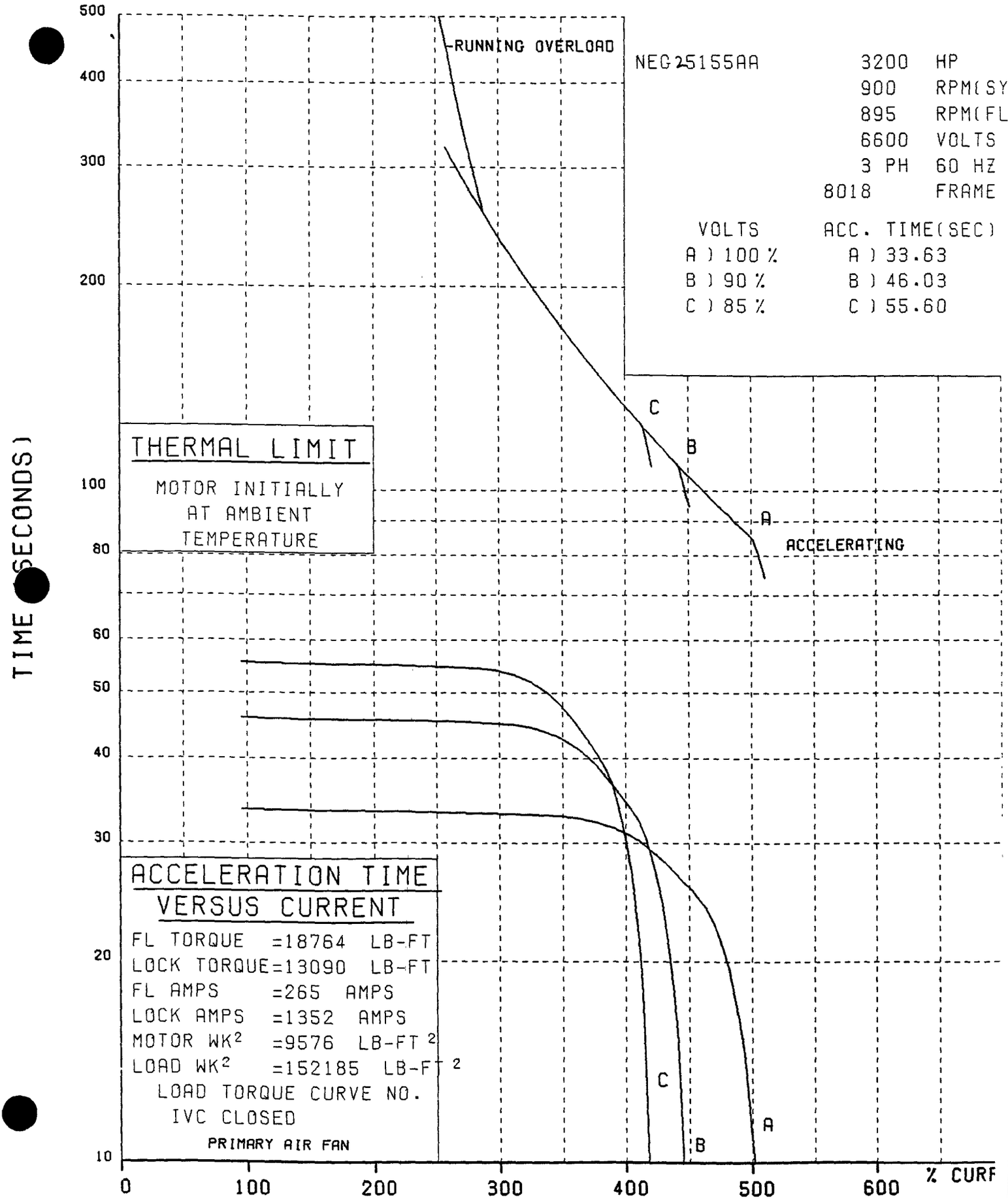
WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

IP12_001908

TIME - CURRENT AND THERMAL LIMIT CURVES

CUSTOMER: INTERMOUNTAIN POWER

ENGINEER: BANSAL



WESTINGHOUSE MOTOR COMPANY ROUND ROCK, TEXAS

CURVE NO. SPB02245

IP12_001909

INTERMOUNTAIN POWER SERVICE CORPORATION

File: 01.12.02
43.5802

September 27, 1990

Lou Krieger Associates
700D Billings St.
Aurora, CO 80011

Dear Mr. Krieger:

Intermountain Power Project Primary Air Fan Testing

We are conducting performance testing on the primary air fans manufactured by Westinghouse, Sturtevant Division for the Intermountain Power Project. We would appreciate your providing us with technical assistance in developing and completing the required fan test procedures.

Preliminary testing of the primary air fans indicates substantial differences between the calculated performance of these fans and the actual performance. We are sending copies of these initial tests for your review and comment.

Please have the appropriate people review the enclosed information and contact us as soon as possible in order to arrange a testing schedule. If you need further information, please contact Jon Christensen at (801) 864-4414, Extension 6481.

Sincerely,

Dennis K. Killian
Superintendent of Technical Services

JPC:JHN:jp
Attachment

cc: S. Gale Chapman

JKH
JHN
JPC

Brush Wellman Road, Delta, Utah / Mailing Address: Rt. 1, Box 864, Delta, Utah 84624 / Telephone: (801) 864-4414 / FAX: (801) 864-4970

TELEFAX COVERSHEET

Lou Krieger Associates

700-D Billings St., Aurora, CO 80011

TELEPHONE: 303/366-3500 TELEFAX: 303/366-0130

TO: LPSC

CITY: Delta STATE: UT

ATTENTION Jon Christensen

TELEFAX NO 801-864-4920 TELEPHONE NO.

THIS IS PAGE 1 OF 3 PAGES IN THIS TRANSMITTAL.

SUBJECT P.A. Test Program

MESSAGE: Hi Jon Sirocco Tech Svc rates follow.

Category would be Engineer Serv.

Circuit Ireland can travel 2/11 so as to be on site Tue. 2/12 and expects one day inspection to suit.

Please advise your recommended accomodations in Delta.

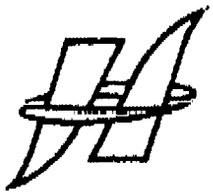
FROM: Jon Krieger

ADDITIONAL DISTRIBUTIONS:

TRANSMITTAL OK ☐

Howden Sirocco, Inc.
One Westinghouse Plaza
Boston, MA 02136
(617) 361-3700
Fax (617) 929-1359

HOWDEN SIROCCO INC.



Howden Sirocco, Inc.
Fluid Drive Service
Gyrol Division
8111 Tireman Avenue
Dearborn, MI 48121
(313) 931-4000
Fax (313) 931-4464

Technical Service and Field Labor Rates (Domestic)

Form TS01 Rev. 10/89

Subject to Change Without Notice

Howden Sirocco Inc (H.S.I.) maintains a staff of competent, trained mechanical service representatives and field service engineers for the purpose of furnishing technical direction and advice during installation, start-up, testing, normal maintenance, inspection and repair of field erected fans, fluid drives and associated mechanical accessories.

Services are offered in the following categories:

Field Labor can be provided on a firm price basis or on a daily basis dependent on customer requirements. For guidance, the applicable daily rates are provided in the Daily Rate Schedule which follows.

Mechanical Service representatives provide technical assistance to customer personnel or provide the technical direction and supervision of labor supplied by H.S.I. during all phases of the contracted work.

Engineer Services are provided by qualified engineers with the capability to perform total system analysis as well as the diagnosis of unusual field difficulties.

Daily Rates

The following daily rates apply in the Continental United States, Hawaii, or Alaska.

- Unless otherwise agreed in writing (e.g. shift work), a normal working day is 8:00 a.m. to 5:00 p.m., during which time the appropriate rate for Monday through Friday, Saturday or Sunday will be charged. An allowance for lunchtime will be made.
- All hours worked in excess of a normal workday will be charged at the stated rates
- All travel time will be charged at the Monday through Friday basic or overtime rate as determined by the actual time of travel
- The total daily rates include wages or salary, Social Security and Worker's Compensation.
- Normal living expenses and local transportation are covered under "Living Expenses Per Diem."
- The minimum charge for any day or part day worked shall be 8 hours at the rate appropriate to the day of the week and the time of day during which work was done plus living expenses, travel costs and equipment rentals.
- Unless otherwise agreed, the cost of travel will be billed as per the Travel Rate Schedule herein.
- Copies of time sheets signed by the customer's representative and receipts for shipping costs of rental equipment not specified will be provided. No other receipts will be provided.
- Invoiced prices will be those in effect at the time service is rendered.

Daily Rate Schedule
U.S. Dollars

	Field Labor	Mechanical Service	Engineer Service	Living Expenses Per Diem
Monday through Friday				
Per 8-hour working day	425	525	680	125
Per hour in excess of 8	65	85	105	
Saturday				
Per 8-hour working day	610	765	975	125
Per hour in excess of 8	95	125	140	
Sunday & National Holiday				
Per 8-hour day	785	970	1260	125
Per hour in excess of 8	95	125	140	
Layover Time — No work Performed (Per Day)				
Monday through Friday	425	525	680	125
Saturday, Sunday & National Holiday	180	235	275	125

Travel Rate Schedule

The travel rates listed are one way from headquarters to the jobsite, and will be added to the appropriate daily rates on the day travel occurs.

FANS

ZONE 1 — Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut	$110 each way
ZONE 2 — All other states east of the Mississippi River	$240 each way
ZONE 3 — All other states west of the Mississippi River (including the Commonwealth of Puerto Rico)	$460 each way

FLUID DRIVES

ZONE 1 — Michigan, Ohio and Indiana	$110 each way
ZONE 2 — All other states east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana	$240 each way
ZONE 3 — All other states west of and including N. Dakota, S. Dakota, Nebraska, Oklahoma, Texas (including the Commonwealth of Puerto Rico)	$460 each way

Rental Equipment

The following daily charges apply to equipment required in connection with normal service. Transportation expenses will be invoiced at cost

Electronic balancing equipment	$220/day
Other equipment and services	To be quoted

Terms

The price does not include any Federal, state or local property taxes, license fees, privilege, sales, use, excise, gross receipts, value added or other like taxes which may now or hereafter be applicable to, measured by or imposed upon or with respect to the transaction, the property, its sale, its value or its use, or any services performed in connection therewith. Such taxes are for the account of the purchaser and the purchaser agrees to pay or reimburse any such taxes which H.S.I. or its contractors or suppliers are required to pay.

Terms of Payment

Payment is due and payable net within thirty (30) days from the date of each invoice.

If payments are not made in accordance with these terms, a service charge shall, without prejudice to the right of Howden Sirocco Inc. for immediate payment, be added to the account of the purchaser in an amount equal to the lesser of 1 1/2% per month on the unpaid balances or that rate if less which shall not violate any law or regulation.

Warranty

Howden [illegible] warrants for a period of [illegible] date of service pursuant [illegible] the technical recom[illegible] Service Personnel shall [illegible] other warranty is [illegible] [illegible] shall prove [illegible] result of defec[illegible] one year after [illegible] to be complete[illegible] written notice [illegible] sole obligation and [illegible] repair or replace F.O.B. factory [illegible] the damaged parts directly [illegible] such defective technical assistance [illegible] liability for defective [illegible] cluding [illegible] technical assistance shall in no case [illegible] of repairing or supplying such [illegible] together with technical assistance for the installation of such repair or replacement parts, a[illegible] expiration of said one year [illegible] such liability shall terminate. H.S.I. shall [illegible] be liable for any loss or injury to persons or property (including the equipment installed) caused in whole or in part (A) by purchaser's employees, contractors, or their employees, agents or subcontractors, (B) by failure to observe the H.S.I. Service Personnel instruction, (C) by failure or malfunctioning of any tools, equipment, facilities or devices not furnished by H.S.I., or (D) by failure of equipment [illegible] the installation of which was not observed or approved by the H.S.I. Service Personnel and purchaser agrees to save HSI harmless from any such liability.

The purchaser shall, without cost to H.S.I., provide access to the work by disassembling, removing, replacing and reinstalling any equipment, materials or structures to the extent necessary to permit H.S.I. to perform its warranty obligations.

All warranty work will be performed on a single-shift, straight-time basis Monday through Friday. In the event the purchaser requests correction of warranty items on an overtime schedule, the premium portion of such overtime shall be to the purchaser's account.

The remedies provided above are the purchaser's sole remedies for any failure of H.S.I. to comply with its obligations. Correction of any nonconformity in the manner and for the periods of time provided above shall constitute complete fulfillment of all the liabilities of H.S.I., whether the claims of the purchaser are based on contract, in tort (including negligence) or otherwise with respect to or arising out of the services or rental items furnished hereunder.

THE ABOVE WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

In no event shall H.S.I. be liable for incidental, consequential or special damages whatsoever.

Cancellation

Unless otherwise agreed, 72 hours notification is required to cancel any service scheduled. A minimum charge of two days plus travel (if applicable) will be made for service which is cancelled without 72 hours notice.

Force Majeure

Howden Sirocco Inc. shall not be liable for failure to perform or for delay in performance due to inclement weather, fire, flood, strike or other labor difficulty, act of God, act of any governmental authority or of the purchaser, riot, sabotage, embargo, car shortage, fuel or energy shortage, wreck or delay in transportation, major equipment breakdown, inability *to obtain necessary labor, materials, or manufacturing facilities from usual sources or due to any cause beyond its reasonable control.*

In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended by a period of time, mutually acceptable by both parties, reasonably necessary to overcome the effect of such delay and the purchaser shall be billed for any additional costs resulting from the delay.

Limitation of Liability

Howden Sirocco Inc., its employees, agents, contractors, suppliers of any tier, shall not be liable in contract, in tort (including negligence), or otherwise for any special, indirect, incidental or consequential damages whatsoever including, but not limited to, loss of profits or revenue, loss of use of equipment or power system, cost of capital, cost of purchased or *replacement power or temporary equipment* claims of customers of the purchaser or damage *or loss of property or equipment*.

The remedies of the purchaser set forth herein are exclusive and the total liability of Howden Sirocco Inc., its employees, agents, contractors and suppliers of any tier with respect to the contract or anything done in connection therewith such as the performance or breach [illegible] from the manufacture, sale, delivery [illegible] of technical direction of installation, maintenance or technical direction of [illegible] or use of any equipment [illegible] whether in contract, in tort [illegible] negligence), or otherwise shall [illegible] price set [illegible]

Indemnification

H.S.I. shall, subject to the provision entitled Limitation of Liability, indemnify and save the purchaser harmless from but only from claims of third parties for physical damage to property and personal injury, including death, occurring during the performance of the work hereunder on the premises of the purchaser and resulting directly and solely from the negligence of the employees of H.S.I. WHILE ENGAGED IN SUCH WORK. H.S.I. shall, with respect to such work, comply with the provisions of the applicable Worker's Compensation Act.

Risk of Loss and Insurance

Risk of loss or damage to the purchaser's equipment shall remain with the purchaser at all times during the performance of work hereunder. Risk of loss or damage to any equipment or material furnished by H.S.I. under the contract shall pass to the purchaser F.O.B. point of shipment. If the purchaser procures or has procured property damage insurance applicable to occurrences at the project site, the purchaser shall obtain a waiver by the insurers of all subrogation rights against H.S.I.

Additional Conditions Applicable to Equipment Rental

In the event Howden Sirocco Inc. rents special tools, instruments or equipment directly to the purchaser, the following conditions shall apply:

1. **Liability**
   The purchaser shall be solely responsible *for the repair or replacement of rented* items damaged or lost while in his possession *or in return shipment.* No alteration or modification of rented items is permitted without H.S.I.'s written consent. H.S.I. assumes no responsibility for the application or use of the items on the purchaser's equipment and the purchaser shall indemnify and hold H.S.I. harmless for any property damage or personal injury resulting therefrom.

2. **Delivery**
   Delivery shall be made F.O.B. point of shipment. Shipment will be made via means specified by the purchaser and at the purchaser's expense.

3. **Rental Period**
   Howden Sirocco Inc. reserves the right to terminate any rental agreement upon written notice to the purchaser.

Termination

Any order or contract may be terminated for convenience by the purchaser only on written notice to H.S.I. Purchaser's obligation will be limited to reimbursement of H.S.I. for all costs incurred up to the date of receipt of [illegible] notification plus a negotiated pro[illegible]

HOWDEN SIROCCO

Howden Sirocco Inc.

Represented By:
Lou Krieger Associates
700 Billings Street, Unit D
Aurora, Colorado 80011
Telephone (303) 366-3500 FAX No. (303) 366-0130

January 16, 1991

Intermountain Power Service Corp.
Box 864
Delta, UT 84624

Attn: Mr. Jon Christensen

Subject: P.A. Fan Testing
Your # Later
Our #BF60/91948

Dear Jon:

This is to acknowledge your subject order for Howden Sirocco, Inc.'s assistance in testing of your Primary Air fans/systems.

Prior to the actual testing a pre-test inspection is in order and Mr. Cecil Ireland of the Company's Engineering Department will be on-site morning of Tuesday February 12, 1991.

His inspection will include:

a. Examination of both inlet vane assemblies to ensure that vanes are correctly adjusted, that they open fully, and that they are all at the same angle. The vanes will be stroked and the external linkage will be marked in such a way that, when closed again, the actual vane position will be known.

b. Examination of the wheel-to-inlet clearances and alignments to ensure that they are within acceptable limits.

c. Appraisal of the inlet traverse location and other test port locations, to ensure that they follow good practice and to ensure that readings are not affected by internal obstructions upstream, such as bracing, expansion joints, etc.

d. Check generally around inlet boxes, housing and evase to ensure that they are as they should be with no obstructions or other faults.

e. Check some leading dimensions on wheel, inlet, and housing.

f. Study duct system upstream and downstream of fan.

Following these inspection procedures time will be taken to meet with yourselves and discuss any problems found on the fan as well as test procedures, instrumentation, review of results already obtained and any other matters of mutual concern.

It should be noted this pre-test inspection is considered to be standard procedure when there is some "mystery" fan performance problem and should not be taken to suggest that we consider the prior testing as incorrect.

Please contact me if anything additional is desired on the above.

Sincerely,

L. W. Krieger

LWK/rm

cc: Cecil Ireland/HSI/Hyde Park
Steve Thayer/HSI/Hyde Park
John McLaughlin/HSI/Hyde Park

HOWDEN SIROCCO

Howden Sirocco Inc.

One Westinghouse Plaza, Suite 300
Hyde Park, MA 02136
Telephone (617) 361-3700
Fax (617) 361-0493

A Howden Group Company

March 8, 1991

Mr. Jon P. Christensen, P.E.
Intermountain Power Service Corporation
Route 1 Box 864
Delta, Utah 84624

Subject: I.P.P. - PA Fan Performance

Dear Jon:

We send herewith our report on the visit and fan inspection carried out February 12, 1991.

If you have comments or further questions, please let us know.

Sincerely,

Cecil Ireland

Cecil Ireland

CI/srm-0643E

cc: L. Kreiger - Aurora, Colorado
J. McLaughlin - Aurora, Colorado

Enclosures:

INTERMOUNTAIN POWER PROJECT
PERFORMANCE OF 120" 2300 SERIES P.A. FANS
REPORT ON PRE-TEST VISIT TO SITE FEBRUARY 12, 1991

INTRODUCTION

Normal operation for the PA fans in this plant is two fans per unit running at 897 RPM, with inlet vane control. However, if one fan goes out, the other switches to 1194 RPM and supplies both sides to maintain 60% boiler load.

In fact, the single-fan high-speed mode is not able to maintain 60% boiler load without seriously over-amping the 4,000 BHP motor. I.P.S.C. has carried out fan tests which suggest the fan performance is down while the power is high. I.P.S.C. recently asked H.S.I. to participate in analyzing the results and in establishing a further program of testing to identify and solve the problem. Accordingly, the writer travelled to site February 12, 1991 to look at the installation generally, and to inspect the two fans on Unit #2 which was on outage.

PA FAN INSPECTION

The fans are clean and in good condition, but some adjustments are necessary.

#2 A FAN:

The aluminum inlet throats are too far into the wheel. They overlap by 0.50" to 0.625" whereas the drawing calls for 0.12" $\pm$ .06. This axial alignment is very critical for optimum performance. The throats are bolted to the inlet cones, using elongated holes and there appeared to be plenty of room to withdraw the throats to the correct position. When withdrawn, the radial clearance between the throat tip and the inner diameter of the wheel side sheets should be approximately .15" to .20" all around. If the throat is very close to (or rubbing) the wheel, the main cone mounting flange in the inlet box must be loosened and repositioned.

Also, on this fan, the inlet vanes do not open fully. The outboard side should open a further 5° to 10° and the motor side should open a further 15° to 20°. The individual vane positions on each side are all fairly uniform, so the correction should be made by adjusting the main link at each side and possibly also the center link from the actuator. To ensure that the vanes reach full-open it is necessary to go into the inlet boxes and visually check the line of the vane against the shaft center.

#2 B FAN:

Both inlet throats on this fan must also be repositioned. They presently overlap the wheel by .60" to 1.00". The inlet vanes on both sides of #2B fan do open fully and no further adjustment is required.

On both fans there were signs of some leakage past the inlet mounting flange - from the housing back into the inlet box; the amount is considered very small and requires no action at this stage.

Some dimensional checks were made on wheels and housings and these are in agreement with drawings.

DISCUSSION

It is difficult to quantify the effect on fan performance due to the inlet throats, but we estimate they may reduce fan efficiency by between 8% and 18%. Adjusting the vanes on #2A fan will also allow more output at low-speed operation.

Unit #1 is scheduled for a three week outage starting March 23. I.P.S.C. personnel are aware of what to look for on the fans and inlet vanes. If adjustments are required, these will be made during first week April with a H.S.I. serviceman present. Following this further tests will be done - the low speed test on both fans during the daytime, with inlet vanes full open on the fan being tested, and the high speed test on one fan being done at night.

The location of the 16 x 4 inlet box traverse is good and should give the volume $\pm$ 3 or 4%. With the existing test ports only a straight probe can be used - either a 3-hole probe or a reverse-flow 'S' type pitot tube. In either case the probe should be accurately calibrated. The flow should be basically straight at this location so an 'S' pitot tube would be acceptable. Static pressure and air temperature should be measured at inlet reverse and at a few points at the outlet traverse location. A VP traverse at outlet is not as reliable and is not necessary. Fan speed should be measured by reliable strobe or optical pick-up. Ambient barometer and wet and dry temperatures should be recorded for density. Power for the PA fans is tied into the variable frequency supply for the I.D. fan and I.P.S.C. uses a Dranetz 808 Power Analyser for test measurements.

It would be very helpful if I.P.S.C. would mark the vane operating mechanisms on the two fans on Unit #1 when the vanes are truly in full open position (after any adustments); also mark for control room positions of 50% and 75%. This is necessary in order to have a reasonably good idea of the actual vane position during the tests.

Some discussion took place regarding the probable change in system which a fan will see when on the single-fan high-speed mode. There is reason to think that the fan will be working much further to the right on its curve and as a result will absorb much more power. However, the upcoming tests will clarify this point.

I.D. FAN INSPECTION

I.P.S.C. also requested an inspection of the #2 I.D. fans to check whether there was any significant abrasion taking place. Fans B and D were inspected and found to be very clean. There was no dust build-up in bottom of inlet boxes or on the wheels or housings. Blade noses and top surfaces were well polished, but original grind marks could still be picked up everywhere. Bolt heads were polished, but there was no loss of metal.

W. C. Ireland

WCI/srm-0643E

Wm. C. Ireland.

March 8 '91

HOWDEN SIROCCO INC

One Westinghouse Plaza

Hyde Park, MA 02136

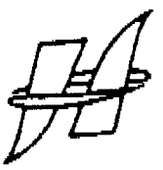
FROM: W.C. Ireland DATE: 3.28.91

DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1.801.864.4970 PAGE 1 OF 3

ATTENTION: JIM NELSON



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SUBJECT: PA FAN TESTS #1 UNIT

Herewith as requested further notes and specification re upcoming tests.

Regards - Ceil Ireland.

HOWDEN SIROCCO

Howden Sirocco Inc.

One Westinghouse Plaza, Suite 300
Hyde Park, MA 02136
Telephone (617) 361-3700
Fax (617) 361-0493

A Howden Group Company

March 28, 1991

Mr. James Nelson
Intermountain Power Service Corporation
Route 1 Box 864
Delta, Utah 84624

Subject: Intermountain Power Project
Upcoming Tests On #1 Unit PA Fans

Introduction

Inspection of PA Fans on #2 Unit showed that inlets and inlet vanes require some adjustment before the fans can be expected to give their rated output. During the present outage on #1 Unit the same inspection and, if necessary, adjustments will be made, following which it is planned to re-test the fans on #1 Unit.

Purpose Of The Tests

1) To establish the performance of each fan at 897 RPM. Volume should be accurate ± 3% to 4% and pressure ± 2% to 3%. Power supply is of special waveform and IPSC is using what it believes is a suitable power analyzer. Howden Sirocco is not expert in power measurement. If there is a serious fan problem this test will show it.

2) To establish the performance of one fan at 1194 RPM. Tolerances will be the same as for the low speed tests. The position of the inlet vanes will be known fairly accurately and if there is a serious fan problem at this speed, this test will show it. Since the idea of the high speed is to be able to maintain reasonable boiler load with only one fan, H.S.I. feel that the most representative test would be to reduce boiler load and run with one fan only. This would show what the system calls for under such conditions and also would show whether the fan and motor have been correctly specified.

   If this is not possible the test can be run with the other fan on low speed. This should still show whether there is a serious fan problem, but it will be operating on a different system line and the vanes will be in a more closed position, whereas the best test of a fan is with the vanes as much open as possible.

Test Details And Instrumentation

Each test should take 2 to 2-1/2 hours. Boiler load should be steady before starting the test and be held steady during the test. On the low speed tests the fan under test should have vanes 100% open if possible. The other fan can be adjusted as required. Volume is obtained from an inlet box traverse. H.S.I. will use an 'S' type calibrated pitot tube. H.S.I. will provide all instrumentation except for power measurement. If there is doubt about any aspect of a test, it will be repeated. The same remarks apply to both low speed and high speed tests except that the inlet vanes cannot be opened to 100% for the high speed test. The fan was selected for this condition with the vanes approximately 60% open.

Manpower And Cost For Test

Normally such tests would have a two man crew from H.S.I. However, IPSC has personnel familiar with testing who will be available to help, so H.S.I. will provide one man in this case. The cost given below includes one day travel each way, two days (and 1 night) on site, two days technical work and preparation before test, four days analysis and report preparation after test, plus all expenses.

Total cost for the visit, based on our present standard rates $8,750.00. ($9,780 if weekend included.)

General

If you have further questions, please let us know. We have discussed the adjustments to the fans with our serviceman Chester Searle who will be on site April 2, 1991.

Regarding stroking the inlet vanes and marking at the actuator, we are also requesting a template of the actual vane position corresponding to the external markings. Further guidance on this will be sent to you early next week. This is so we know the exact vane position (± say 3%) during test.

We want to assure you that we believe we are moving along the right path towards understanding and solving your problem. We have to have reliable results (after adjusting the fans) before going on to the next stage. The upcoming tests should go a long way towards answering present questions.

Sincerely,

Cecil Ireland

Cecil Ireland

CI/srm-0674E

cc: Messrs. S. Thayer - Hyde Park, MA
L. Krieger - Aurora, CO
J. McLaughlin - Aurora, CO

HOWDEN SIROCCO INC

One Westinghouse Plaza
Hyde Park, MA 02136

FROM: W.C. Ireland DATE: 4.1.91

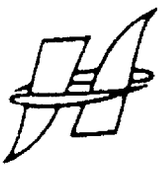
DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1·801·864·4970 PAGE 1 OF 1

ATTENTION: JIM NELSON 6464

(FOR H.S.I. SERVICEMAN CHESTER SEARLE)



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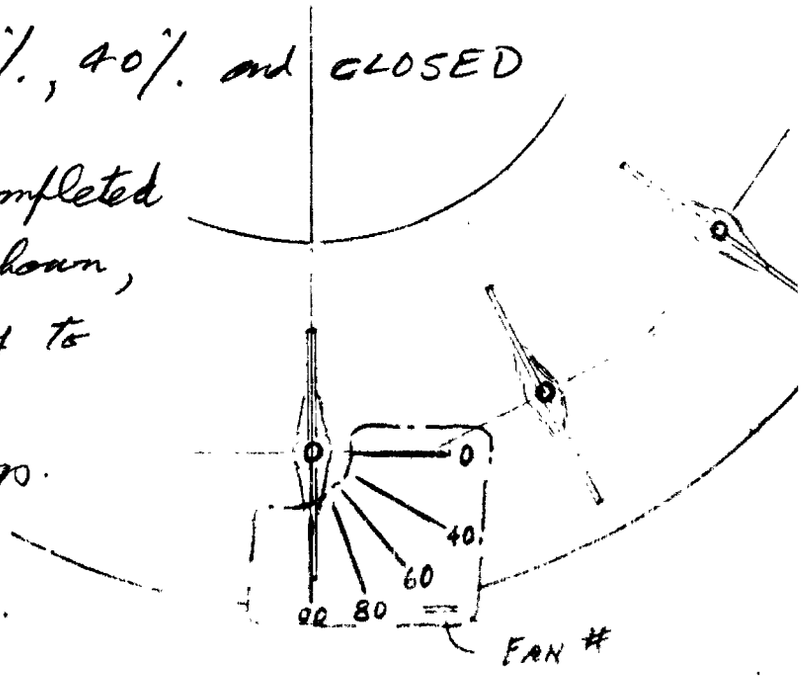
SUBJECT: INLET VANE MEASUREMENT P.A. FANS #1

1. after completing any necessary adjustments to vanes, set vanes full open (100%).
2. Choose one representative vane in each inlet box of each fan (4 total).
3. Place a sheet of paper or thin card on the inlet as shown and tape to hold in place.
4. Mark 100%, 80%, 60%, 40% and CLOSED
5. If these templates are completed and properly identified as shown, it will not be necessary to mark % positions at the actuators on top of housings.
6. Return templates to me.



Thank you

HOWDEN SIROCCO INC
1 WESTINGHOUSE PLAZA
HYDE PARK, MA 02136
TEL: (617) 361-3700

SERVICE ORDER RECORD

SALES OFFICE	SERVICE ORDER NO. DF 60/ 71963
SALES PERSON	ORIGINAL SALES/SERIAL # ARY - 6091
CUSTOMER P.O.# 91-44[illegible]	FIELD SERVICE X / ENG SERVICE / OTHER
ORIGINAL MFG'S NAME WESTINGHOUSE	ORDER COMPLETE YES ☒ NO ☐ / COURTESY CALL ☐ YES ☒ NO
EQUIPMENT 2- 3110 PA FANS UNIT 1	☐ ERECTION ☐ START-UP ☑ INSPECTION ☑ REPAIR
CUSTOMER IDENT # 2-A + 2-B	
THIS ORDER COVERS TIME & EXPENSE OF *HOWDEN SIROCCO* SERVICE REP.	

CUSTOMER

JOB LOCATION

BRIEF DESCRIPTION OF PURPOSE OF TRIP/RESULTS [illegible] INSPECTION & TRIAL OF INLET VANES
[illegible] - INLET CLEARANCE
[illegible] IN 2-A FAN

YEAR	MONTH	STR. HOURS (W) WORKED (T) TRAVEL	O. TIME HRS. WORKED (W) TRAVEL (T)	TOTAL HOURS	V. A.	EXPENSES LODGING	MEALS				TOTAL
SUN											
MON											
TUES											
WED											
THUR											
FRI											
SAT											
TOTALS											

TOTAL MON/FRI WORK/TRAVEL			← →	_____ DAYS @ _____ _____ O.T. HRS. @ _____		
TOTAL SATURDAY			← →	_____ DAYS @ _____ _____ O.T. HRS. @ _____		
TOTAL SUNDAY/HOLIDAYS			← →	_____ DAYS @ _____ _____ O.T. HRS. @ _____		
TOTAL PER DIEM			← →	_____ DAYS @ _____		
TOTAL BALANCE MACH. (V.A.)				_____ DAYS @ _____		

THE CUSTOMER IS REQUESTED TO SIGN THIS SHEET TO SHOW HIS AGREEMENT WITH THE TIME WORKED. EVEN THOUGH THE CONTRACT OR PROPOSAL MAY PROVIDE FOR THE SERVICES TO BE FURNISHED AT NO CHARGE.

FIRM NAME

CUSTOMER REPRESENTATIVE

HOWDEN SIROCCO REPRESENTATIVE EMP. #

CHECKED APPROVED

TOTAL LABOR	
PERSONAL CAR _____ MILES @ _____	
TOTAL REIMBURSABLE EXPENSES	
AIR TRAVEL TICKET(S)	
CAR RENTAL # _____ COMPANY _____	
COMPANY CAR _____ MILES @ _____	
TOTAL EXPENSES	
TOTAL LABOR & EXPENSES	
TOTAL AMOUNT OF THIS ORDER	

WHITE-ACCOUNTS PAYABLE; CANARY-SERVICE DEPT; PINK-SERVICE REP; GOLDENROD-CUSTOMER

IP12_001923

REQ 59449 IPSC FOR MOD (DATA COLLECTION)

TELEFAX COVERSHEET

Lou Krieger Associates

700-D Billings St., Aurora, CO 80011

TELEPHONE: 303/366-3500 TELEFAX: 303/366-0130

TO: IPSC

CITY: Delta STATE: UT

ATTENTION: Jon Christensen

TELEFAX NO. 801-864-4970 TELEPHONE NO.

THIS IS PAGE 1 OF 4 PAGES IN THIS TRANSMITTAL.

SUBJECT: PA Fan Test

MESSAGE: Current rate sheet follows. Category would be "Engineer". This sheet would be applicable only if test took longer than provided for in lump sum pricing on page 2 of Cecil Ireland 3/28/91 letter enclosed.

Cecil is not available until week later than your request i.e. June 13, 14, 15. Is that acceptable?

FROM: Jon

ADDITIONAL DISTRIBUTIONS:

TRANSMITTAL OK ☐

DATE 5/24/91

HOWDEN SIROCCO

Howden Sirocco Inc.

One Westinghouse Plaza, Suite 300
Hyde Park, MA 02136
Telephone (617) 361-3700
Fax (617) 361-0493

A Howden Group Company

March 28, 1991

Mr. James Nelson
Intermountain Power Service Corporation
Route 1 Box 864
Delta, Utah 84624

Subject: Intermountain Power Project
Upcoming Tests On #1 Unit PA Fans

Introduction

Inspection of PA Fans on #2 Unit showed that inlets and inlet vanes require some adjustment before the fans can be expected to give their rated output. During the present outage on #1 Unit the same inspection and, if necessary, adjustments will be made, following which it is planned to re-test the fans on #1 Unit.

Purpose Of The Tests

1) To establish the performance of each fan at 897 RPM. Volume should be accurate + 3% to 4% and pressure ± 2% to 3%. Power supply is of special waveform and IPSC is using what it believes is a suitable power analyzer. Howden Sirocco is not expert in power measurement. If there is a serious fan problem this test will show it.

2) To establish the performance of one fan at 1194 RPM. Tolerances will be the same as for the low speed tests. The position of the inlet vanes will be known fairly accurately and if there is a serious fan problem at this speed, this test will show it. Since the idea of the high speed is to be able to maintain reasonable boiler load with only one fan, H.S.I. feel that the most representative test would be to reduce boiler load and run with one fan only. This would show what the system calls for under such conditions and also would show whether the fan and motor have been correctly specified.

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ALLEN 806 0A

Mr. James Nelson
Page Two
March 28, 1991

Test Details And Instrumentation

Each test should take 2 to 2-1/2 hours. Boiler load should be steady before starting the test and be held steady during the test. On the low speed tests the fan under test should have vanes 100% open if possible. The other fan can be adjusted as required. Volume is obtained from an inlet box traverse. H.S.I. will use an 'S' type calibrated pitot tube. H.S.I. will provide all instrumentation except for power measurement. If there is doubt about any aspect of a test, it will be repeated. The same remarks apply to both low speed and high speed tests except that the inlet vanes cannot be opened to 100% for the high speed test. The fan was selected for this condition with the vanes approximately 60% open.

Manpower And Cost For Test

Normally such tests would have a two man crew from H.S.I. However, IPSC has personnel familiar with testing who will be available to help, so H.S.I. will provide one man in this case. The cost given below includes one day travel each way, two days (and 1 night) on site, two days technical work and preparation before test, four days analysis and report preparation after test, plus all expenses.

Total cost for the visit, based on our present standard rates $8,750.00. ($9,780 if weekend included.)

General

If you have further questions, please let us know. We have discussed the adjustments to the fans with our serviceman Chester Searle who will be on site April 2, 1991.

Regarding stroking the inlet vanes and marking at the actuator, we are also requesting a template of the actual vane position corresponding to the external markings. Further guidance on this will be sent to you early next week. This is so we know the exact vane position (± say 3%) during test.

We want to assure you that we believe we are moving along the right path towards understanding and solving your problem. We have to have reliable results (after adjusting the fans) before going on to the next stage. The upcoming tests should go a long way towards answering present questions.

Sincerely,

Cecil Ireland

CecIl Ireland

CI [illegible]-0674E

cc: [illegible] S. Thayer - Hyde Park, MA
L. Krieger - Aurora, CO
J McLaughlin - Aurora, CO

Howden Sirocco, Inc.
One Westinghouse Plaza
Boston, MA 02136
(617) 361-3700
Fax (617) 929-1359

HOWDEN SIROCCO INC.

Howden Sirocco, Inc.
Fluid Drive Service
Gyrol Division
8111 Tireman Avenue
Dearborn, MI 48121
(313) 931-4000
Fax (313) 931-4464

Technical Service and Field Labor Rates (Domestic)

Form TS01 Rev. 08/90

Subject to Change Without Notice

Howden Sirocco Inc (H.S.I.) maintains a staff of competent, trained mechanical service representatives and field service engineers for the purpose of furnishing technical direction and advice during installation, start-up, testing, normal maintenance, inspection and repair of field erected fans, fluid drives and associated mechanical accessories.

Services are offered in the following categories:

Field Labor can be provided on a firm price basis or on a daily basis dependent on customer requirements. For guidance, the applicable daily rates are provided in the Daily Rate Schedule which follows.

Mechanical Service representatives provide technical assistance to customer personnel or provide the technical direction and supervision of labor supplied by H.S.I. during all phases of the contracted work.

Engineer Services are provided by qualified engineers with the capability to perform total system analysis as well as the diagnosis of unusual field difficulties

Daily Rates

The following daily rates apply in the Continental United States, Hawaii, or Alaska:

- Unless otherwise agreed in writing (e.g., shift work), a normal working day is 8:00 a.m. to 5.00 p.m., during which time the appropriate rate for Monday through Friday, Saturday or Sunday will be charged. An allowance for lunchtime will be made.
- All hours worked in excess of a normal workday will be charged at the stated rates.
- All travel time will be charged at the Monday through Friday basic or overtime rate as determined by the actual time of travel.
- The total daily rates include wages or salary, Social Security and Worker's Compensation.
- Normal living expenses and local transportation are covered under "Living Expenses Per Diem."
- The minimum charge for any day or part day worked shall be 8 hours at the rate appropriate to the day of the week and the time of day during which work was done plus living expenses, travel costs and equipment rentals
- Unless otherwise agreed, the cost of travel will be billed as per the Travel Rate Schedule herein.
- Copies of time sheets signed by the customer's representative and receipts for shipping costs of rental equipment not specified will be provided. No other receipts will be provided.
- Invoiced prices will be those in effect at the time service is rendered.

Daily Rate Schedule
U.S. Dollars

	Field Labor	Mechanical Service	Engineer Service	Living Expenses Per Diem
Monday through Friday				
Per 8-hour working day	465	575	750	175
Per hour in excess of 8	70	95	115	
Saturday				
Per 8-hour working day	670	840	1075	175
Per hour in excess of 8	105	135	155	
Sunday & National Holiday				
Per 8-hour day	865	1065	1385	175
Per hour in excess of 8	105	135	155	
Layover Time — No work Performed (Per Day)				
Monday through Friday	465	575	750	175
Saturday, Sunday & National Holiday	465	465	465	175

Travel Rate Schedule

The travel rates listed are one way from headquarters to the jobsite, and will be added to the appropriate daily rates on the day travel occurs.

FANS
ZONE 1 — Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut
ZONE 2 — All other states east of the Mississippi River
ZONE 3 — All other states west of the Mississippi River (including the Commonwealth of Puerto Rico)

FLUID DRIVES
ZONE 1 — Michigan, Ohio and Indiana
ZONE 2 — All other states east of and including Minnesota, Iowa, Missouri, Arkansas and Louisiana
ZONE 3 — All other states west of and including N. Dakota, S. Dakota, Nebraska, Oklahoma, Texas (including the Commonwealth of Puerto Rico)

Cost plus 15%

Rental Equipment

The following daily charges apply to equipment required in connection with normal service Transportation expenses will be invoiced at cost:

Electronic Balancing Equipment	$220/day
Other equipment or Services	To be quoted

HOWDEN SIROCCO

Howden Sirocco Inc.

Represented By
Lou Krieger Associates
700 Billings Street, Unit D
Aurora, Colorado 80011
Telephone (303) 366-3500 FAX No. (303) 366-0130

May 28, 1991

Intermountain Power Service Corporation
Box 864
Delta, UT 84624

Attn: Mr. Jon Christensen

Subject: P.A. Fan Test

Dear Jon:

This will confirm recent conversations relative to Cecil Ireland's testing of your P.A. fans.

The schedule is for Cecil to travel on Thursday June 13, meet with yourselves Friday June 14, with the test being conducted on Saturday June 15.

Cecil will then prepare a report so as to have it in your hands prior to June 30.

We understand you will have personnel available to assist Cecil in this testing.

Sincerely,

L. W. Krieger

cc: Cecil Ireland/HSI/Hyde Park
John McLaughlin/HSI/Aurora

HOWDEN SIROCCO INC

One Westinghouse Plaza
Hyde Park MA 2136

FROM: W.C. Ireland DATE: 6.28.91

DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1.801 864-4970 PAGE 1 OF 4

ATTENTION: JON CHRISTENSEN

****

SUBJECT: P.A. FAN PERFORMANCE

Herewith an update on our deliberations on these fans.

If you have further questions or thoughts please don't hesitate to call.

Regards Cecil Ireland.

cc Lou Krieger.

June 28, 1991

INTERMOUNTAIN POWER PROJECT

UPDATE ON ANALYSIS OF PERFORMANCE OF P.A. FANS

Attention: Jon Christensen

As promised we are sending you this update on our analysis of the P.A. fan performance.

We have calculated the results of the June 22 tests and they basically confirm the earlier figures from your tests. Because only one fan is feeding the unit the system line is further to the right on the fan curve, as would be expected.

If we accept the powers measured by you, then the efficiency of the fans is significantly lower than it should be - especially at the higher speed. We do not see any one reason why this should be; such things as rotation and vane direction have been checked, also a few leading dimensions on wheel and housing have been checked.

We are, therefore, looking at a number of other aspects as follows:

Original Selection:	We will check to see whether Westinghouse was fair and accurate in the fan selection.
Curve Accuracy:	Further study of the recently drawn curve with vane settings shows that some regions of this are not accurate. The efficiency between the 30° and 45° settings calculates to be almost as good as the top curve and we know this is not right.
Fan Output/Vane Position:	The tests show the fan output to be higher than it should be for the vane angle at which it was supposed to be set. From the vane stroking which our serviceman did we should know the vane angle within ± 3°.
Velocities:	We are looking closely at the air velocities through the fan compared to those in the dozens of other units which are working satisfactorily in the field.

Unfortunately, there is margin on motor power on these units. Test block BHP at low speed is 2,217 while motor nameplate HP is 2,100. At high speed it is 3,989 BHP with a 4,000 HP motor. The fact that the system line moves to the right can add 3% or 4% to power.

One of the reasons why the high speed performance is so poor is because the vanes have to be closed down so much (to keep the amps down) and the efficiency at this condition is very low. As an example, if the vanes could be opened a further 10° the efficiency would improve by 20% to 25%.

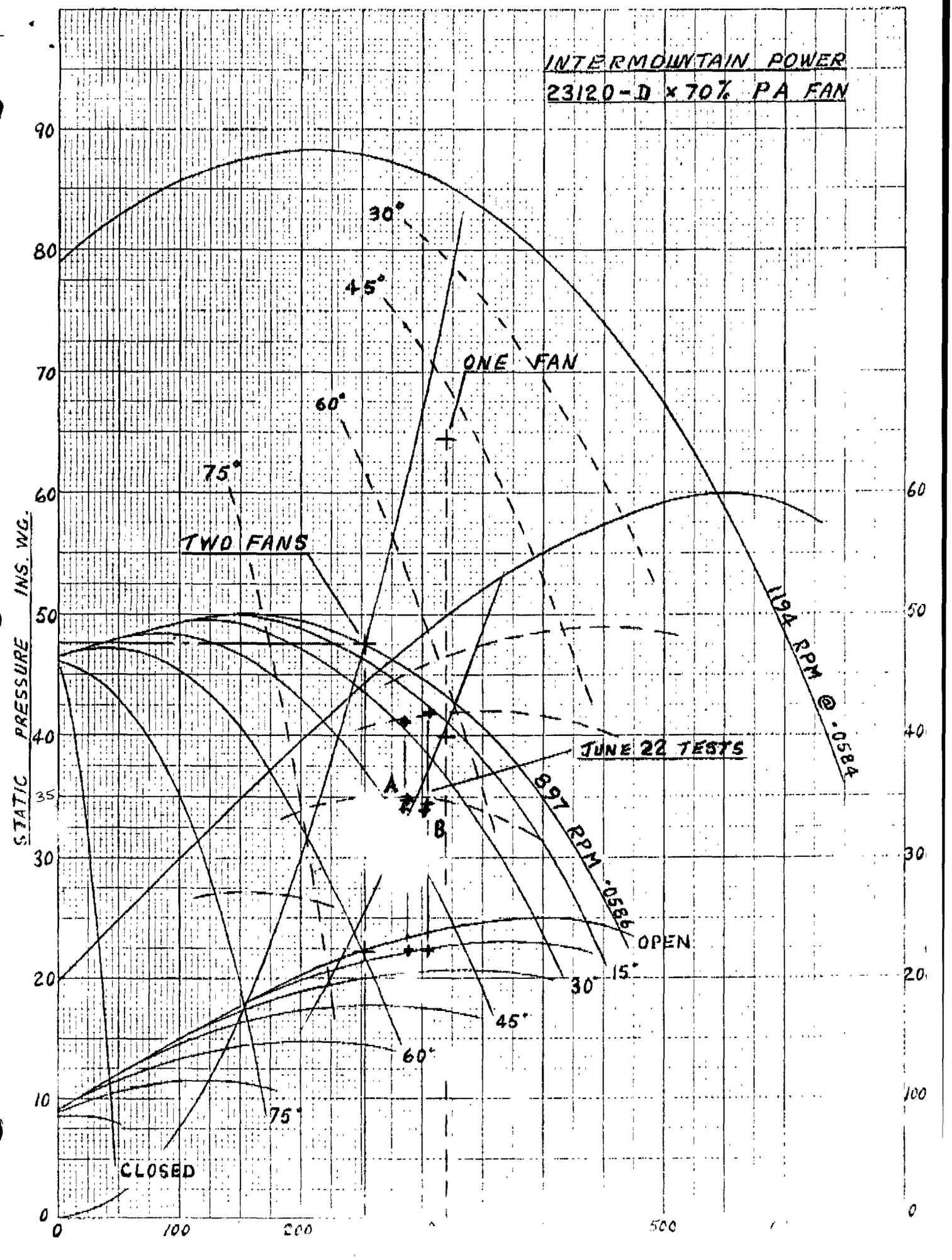
There are vane tabs on these vanes, to prevent vibration which sometimes occurs at mid vane settings. These probably reduce efficiency by a couple of points so removing these would not make much contribution. Another way of achieving more open vanes is to de-tip the wheel. However, with these aerofoil blades only very limited de-tipping could be done.

We will continue to study the figures and other data to establish how much shortfall in efficiency is present and the likely causes for it. We will try to have more specific conclusions in about 10 days.

Cecil Ireland.

W. C. Ireland
Senior Development Engineer

WCI/srm-0824E



OWDEN SIROCCO INC
Westinghouse Plaza
le[redacted], MA 02136

FROM: W.C. Ireland DATE: 1st July 91

DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1·801·864·4970 PAGE 1 OF 4

ATTENTION: JON P. CHRISTENSEN

****

SUBJECT: P.A. FAN TEST RESULTS

ATTACHED IS ONE PAGE SHOWING A SUMMARY OF THE RAW DATA. THE FOLLOWING TWO PAGES SHOW THE CALCULATION OF PERFORMANCE BASED ON THIS DATA FOR TEST (1).

THE INVOICE FOR THIS TEST WILL BE MAILED TO YOUR ATTENTION TOMORROW JULY 2nd. AS REQUESTED.

IF YOUR REQUIRE FURTHER CLARIFICATION OF THE RESULTS PLEASE CALL US.

Regards

Neill Shaw

HOWDEN SIROCCO INC.
One Westinghouse Plaza
Hyde Park, MA 02136

TEST SUMMARY:

2 OF 4

SIDE	TP_{IN} "WG	VP_{IN} "WG	SP_{IN} "WG	SP_{OUT}	BAR	T_D	T_W	T_{IN}	T_{OUT}	RPM
DRIVE	-.619	.4502	-1.578		25.41	72	54	67.3		898
OUT		.376	-.803	37.05	25.40	64	51	67.7	99.8	897
DRIVE		.4414	-.9903		25.41	65	46	64.8		1194
OUT	-.4837	.376	-.6958	36.53	254	63	51	68.7	114.7	
DRIVE	-.5113	.4671	-.6156		25.44	65	46	66.3		
OUT	-.586	.4766	-.7895	37.05	2545	65	46	66.4	93.6	897
DRIVE	-.579	.4565	-.6022		25.47	70	49	75.2		
OUT	-.593	.447	-.749	36.734	25.46	69	49	69.4	118.6	

HOWDEN SIROCCO INC. One Westinghouse Plaza Hyde Park, MA 02136

#4

TEST 1 PA FAN 2A LOW SPEED

CALCULATION OF TEST RESULTS:

DRIVE SIDE

$T_{DRY} = 72°F \quad T_{WET} = 54°F \quad BAR. = 25.41"Hg$

FROM AMCA 203 FIG. N-1 $\rho_o = 0.0631\ lb/ft^3$

OUTBOARD SIDE

$T_{DRY} = 64°F \quad T_{WET} = 51°F \quad BAR = 25.4"Hg$

gives $\rho_o = 0.0641$

DRIVE SIDE

Density at Traverse $\rho_3 = \rho_o \left(\frac{P_{s_3} + 13.6 P_b}{13.6 P_b}\right)\left(\frac{td_o + 460}{td_3 + 460}\right)$

- ambient
- traverse

$$\rho_3 = 0.0631\left(\frac{-1.578 + 13.6 \times 25.41}{13.6 \times 25.41}\right)\left(\frac{72+460}{673+469}\right)$$

$$\rho_3 = 0.06337\ lb/ft^3$$

Traverse Area = $51.45\ ft^2$

Velocity at Traverse $V_3 = 1096\sqrt{\frac{P_{v_3}}{\rho_3}} = 1096\sqrt{\frac{.4502}{.06337}}$

$= 2921$ fpm

Volume flow at Traverse $Q_3 = 2921 \times 51.45$

Volume at Inlet $Q_1 = Q_3 = 150304$ cfm

OUTBOARD SIDE

$$\rho_3 = 0.0641\left(\frac{-.803 + 13.6 \times 25.4}{13.6 \times 25.4}\right)\left(\frac{64+460}{677+460}\right)$$

$$= 0.0641 \times .9977 \times .99299 = 0.063504\ lb/ft^3$$

Traverse Area = $51.45 ft^2$

$$V_3 = 1096\sqrt{\frac{.376}{.063504}} = 2666.88 fpm$$

$$Q_1 = Q_3 = 2666.88 \times 51.45 = 137211 cfm$$

TOTAL FLOW AT INLET = 287515 cfm

HOWDEN SIROCCO One Westinghouse Plaza Hyde Park, MA 02136

#4

Fan Static Pressure $= P_{S_2} - P_{T_1}$

$= 37.05 - \left(\frac{-.619 - .463}{2}\right)$

$= 37.591$

CONVERT TO CURVE CONDITIONS.

Test Speed = Curve Speed

Test Size = Curve Size

Test density = 0.0636

Curve density = 0.0586.

Curve flow = 287515 cfm

Curve Pressure = $37.591 \times \frac{.0586}{.0636}$

$= 34.64"$ Wg

Vanes at 57% open.

or 5. ° VANES ANGLE SETTING

HOWDEN SIROCCO INC
O[illegible] Westinghouse Plaza
Hyde Park, MA 02136

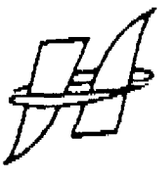
FROM: W.C. Ireland DATE: 7.24.91

DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1·801·864·4970 PAGE 1 OF 5

ATTENTION: JON CHRISTENSEN



****

SUBJECT: P.A. FAN PERFORMANCE

Herewith our analysis of the PA fan performan. We apologize for the delay but there was more work and cross-checking involved than we first thought.

Regards, Cecil Ireland.

HOWDEN SIROCCO

Howden Sirocco Inc.

One Westinghouse Plaza, Suite 300
Hyde Park, MA 02136
Telephone (617) 361-3700
Fax (617) 361-0493

A Howden Group Company

July 24, 1991

Intermountain Power Service Corporation
Route 1 Box 864
Delta, Utah 84624

Attention: Mr. Jon Christensen

Subject: I.P.P. - P.A. Fan Performance

Dear Jon:

Further to our update of June 28, 1991, we give below the findings from our analysis of the problems assocated with one - fan operation at the Intermountain plant and we discuss the options available to overcome these problems.

There are three main factors causing the problem.

Firstly, as already stated, the tests have shown the fan efficiency to be lower than expected, especially at the high speed operating point. We now know that this has happened because some of the lower load regions of the basic selection data were incorrect.

Secondly, there is no margin on motor power. The quoted test block BHP at 897 RPM is 2217 while the motor is rated at 2000 HP and the 5% service factor raises this to only 2100 HP. At the high speed duty the quoted BHP is 3989 with a motor rating of 4000.

The combination of lower efficiency and motor power limitation creates a 'Catch 22' situation. The vane setting has to be reduced to keep the amps down and this reduces fan efficiency still further. The present fans are capable of developing much more output at both speeds and of doing it more efficiently, if only the vanes could be opened further.

Another factor which is adding to the problem is that the actual operating systems for one and two - fan operation are to the right hand side of the original specified systems. Depending on the actual volume-pressure required, this can add from zero to 4% to power at low speed and zero to about 6% at high speed. It seems that the possibility of a variance in operating system, particularly under one - fan operation, was not taken into account when sizing the motors.

There appears to be only two options available to overcome the problem.

1. Replacing the present wheels and inlets.

   We have tried a considerable number of wheel selections and find that none of these will develop the original MCR duty of 252000 CFM at 47 ins WG and do it within the present motor limit of 2100 BHP.

   This prompted us to look at other possibilities. Our first idea was that, in the light of operating experience, the opportunity should be taken to re-specify the load points. We have, therefore, chosen revised load points as follows. These points take into account the fact that the systems are futher to the right and also we have reduced the pressures to keep within motor powers. Your earlier tests indicate that 100% MCR operation required about 37 ins. WG (on graph conditions). We have marked these new points on the test results graph for comparison.

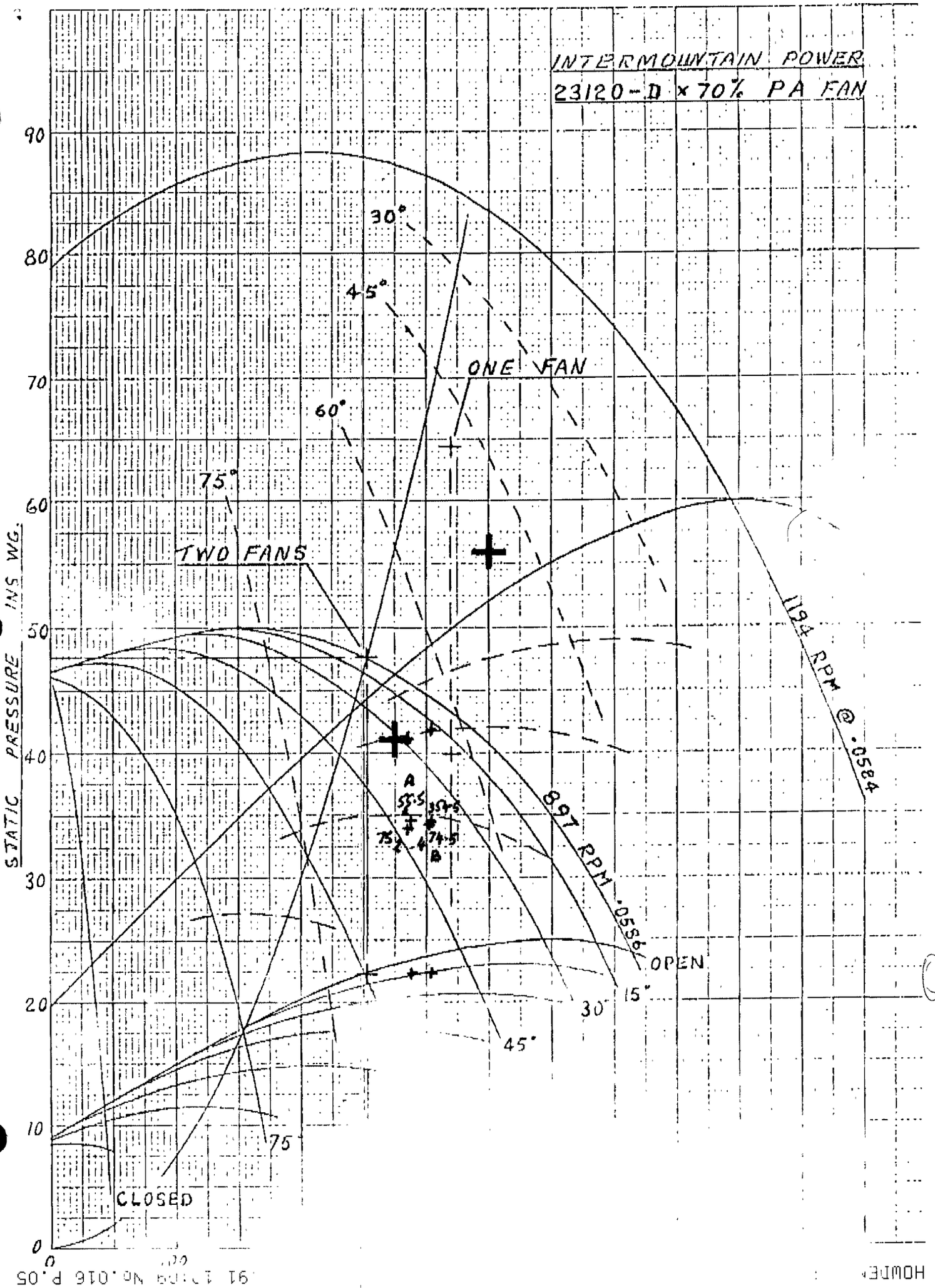
   MCR: 275,000 CFM @41 Ins. SP.
   High Speed: 350,000 CFM @56 Ins. SP.

   However, even this course has problems. We can certainly select 2 or 3 different wheels which will achieve these duties within the present motor power. Unfortunately, for the wheel sizes required, the present housing is not sufficiently close to what it should be, which creates doubt as to whether this arrangement would perform satisfactorily.

   This leaves us with one other suggestion, which is to select the fans for the high speed duty and to run at high speed for both modes. This means we could cope with a high speed duty of 350000 CFM at 57 to 58 ins. WG and stay well within the 4000 power limit. The MCR operation would be achieved by closing the vanes. There would no longer be a power or output limitation at MCR and our selections show that the efficiency at this vane setting would be about the same as is presently achieved at this load. The wheel diameter would be much the same as at present and thus the housing will be close to what is required.

2) Replace the motors.

   The other option for solving the problem is obviously to modify or replace the motors. This option would be more expensive and a longer lead time would be associated with it.



46 1242

K&E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

We hope the foregoing will be helpful in deciding the most viable course of action and we await your comments with regard to the new duty points. If the high speed option as discussed above is acceptable, we would be able to fine tune the selection and work up budget prices and delivery information within 5 or 6 days.

Sincerely,

Wm C. Ireland.

W. C. Ireland
Senior Development Engineer

WCI/srm-0840E

cc: Mr. L. W. Krieger - Aurora, CO
Mr. R. E Mahoney
Mr. J. P. Srivastava
Mr. R. G. Eddy

HOWDEN SIROCCO INC

One Westinghouse Plaza

Hyde Park, MA 02136

FROM: W.C. Ireland DATE: 8.21.91

DEPT: Engineering

TEL: (617) 361-3700 EXT-239 FAX: (617) 361-0493

TO FAX #: 1.801.864.4970 PAGE 1 OF 6

ATTENTION: JON CHRISTENSEN

****

SUBJECT: P.A. FANS

Please find attached specific performance figures, also prices and delivery, for proposed new 112" TVAF 6A wheels for above fans.

Regards - Cecil Ireland.

HOWDEN
SIROCCO
INC.
One Westinghouse Plaza
Hyde Park, MA 02136

Intermountain Power Project
Delta, Utah 84624

August 21 1991

attention : Mr. Jon Christensen

Replace wheels for P.A. Fans.

Further to our letter of July 24 91 and to our telephone conversations since then, I now give details of the three duty requirements with probable BHP values. These are also shown on the graph herewith.

I was only partly correct in saying that the two lower duties could be achieved within the present motor power. The full volumes can be achieved and the power for 100% load is not much above the motor limit but the 300 MW power is not possible with present motors.

The duties and powers are as follows :

60% boiler load – max. resistance (1 fan)

320,000 CFM 64 in WG 4100 BHP 1194 RPM. C = .584

100% boiler load — 1 fan

480,000 CFM 43 ins WG 4314 BHP 1194 RPM .0584 ℄

300 MW boiler load — 1 fan

590,000 CFM 34 ins WG 4931 BHP 1194 RPM .0584 ℄

NOTES

1. The TVAF 6 design has proven to be a good retrofit wheel. It has been used in many large installations with satisfactory results.

2. I refer to the BHP values as 'probable' because, as with all retrofits — which are non-standard assemblies of wheel, housing and inlet boxes, some de-rating of efficiencies is applied to allow for those effects. In this case a relatively large de-rate (approx 11%) has been applied to the base efficiencies to obtain the powers. This value is based on laboratory and field tests and on our general experience over the years. It is also a safety margin so that we feel confident that the figures we put forward are achievable.

3. On the 100% load I have used 43 in SP at .0584 density on the assumption that the 44 in was relative to a higher density of about .06. Also, the original specification called for 252,000 CFM but I.P.P. tests indicated about 240,000 CFM. However, I believe a second fan was supplying some air during the IPP tests which could mean that 252000 is the more correct figure. If 252000 at 44 in is taken as the 100% load, the power would be 4663 BHP which is well outside motor limit.

4. The 4663 power is 11% above motor limit and the 4931 power is 17.4% above the limit. It may be of help to you to know how much flow cut-back would be required to bring these powers within the 4200 motor limit! For the 100% load a flow reduction of 3.6% would be required and for 300 MW 5.5% would be necessary. This is assuming a parabolic system curve; if the system is virtually constant pressure (for the mills) then the full power excess would have to be obtained by flow reduction.

I hope the foregoing answers your questions ; if you need further details please let us know . Budgetary prices are given below . New shafts have been included but the present shafts may be acceptable — we have still to check .

Wheel — 93,000 each ; includes new hubs and allowance for cut-off modification .
Shaft — 32,000 each .
Inlets — 12,000 pair .

Delivery — 9 to 10 months — could possibly be improved . Disassembly and reassembly of IVC on site is required .

Reference # P 91 WB 222

Sincerely ,

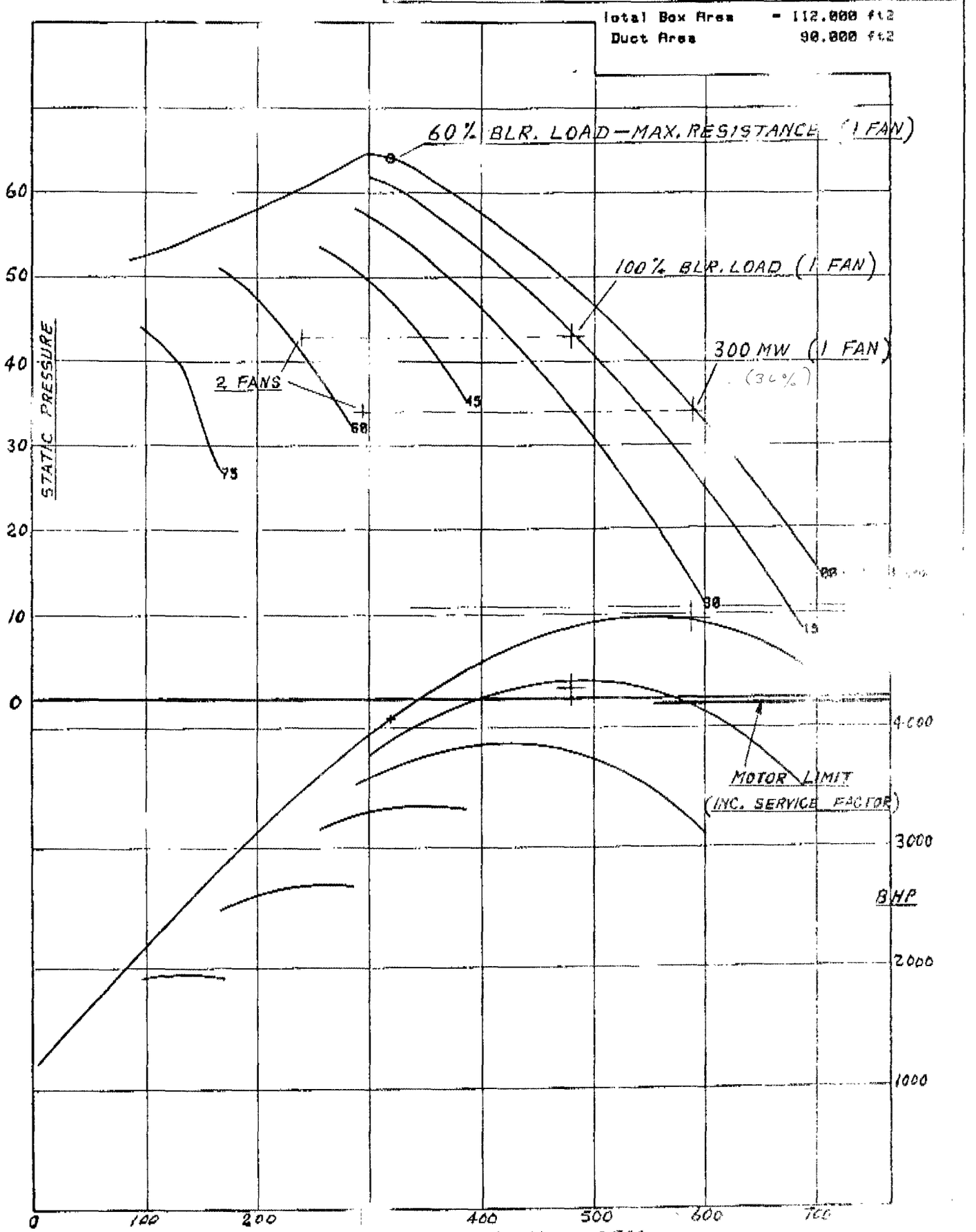
Cecil Ireland .

cc Lou Krieger .
John McLaughlin .
E. Mahoney .
S. Srivastava .
R. Eddy .

HOWDEN SIROCCO INC.
One Westinghouse Plaza
Hyde Park, MA 02136

112.0 ins DI *TVAF6A at 1194 RPM

with BOX and VIV control gear.



REF. I.P.P.

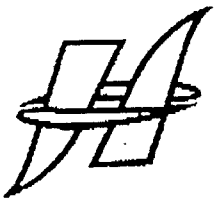
CURVE.

HOWDEN SIROCCO

Howden Sirocco Inc.

One Westinghouse Plaza, Suite 300
Hyde Park, MA 02136
Telephone (617) 361-3700
Fax (617) 361-0493

A Howden Group Company



August 5, 1992

To: Intermountain Power Service Corp.

Attention: Mr. Jon Christensen

From: Mr. Cecil Ireland

F A X M E S S A G E

Subject: I.P.P. - PA Fan Performance

Please find herewith revised curves for the PA fans at Intermountain Power, Delta, Utah. We apologize for our poor response in getting these curves out to you.

We have redrawn the curves, making separate ones for high and low speed.

The output of the top (90°) curve has been reduced slightly in line with other test data. The vane closure curves have been 'bunched' towards the top curve and this makes the angles at the test points agree closely with what was recorded during the tests. The power curves have been reconstructed to give efficiencies observed on other tests and also to give the as - tested efficiencies at Intermountain. Finally, we have labelled the curves in degrees from closed, which is in line with your nomenclature. These now are, in effect, customized curves for the Intermountain project.

Turning now to Westinghouse report WMC-EER-92-002, this redefines allowable motor powers as 5000 HP at 1194 RPM and 3200 HP at 897 RPM and it is our understanding that a 1.15 service factor on top of these values can be accommodated.

Two-Fan Low Speed Operation

We have indicated the nominal limit of 3,200 HP on the graph and it may be seen that any point on the curve is well within this power, without having to use any of the service factor.

One-Fan High Speed Operation

The tests showed the operating system to be to the right of the original specified system and we have shown this operating system as a dotted line. It is assumed, for purposes of discussion here, that higher fan loadings would lie on this line. Again we have shown lines for the power limitations. It may be seen that a duty of 375,000 CFM at 56.5 ins. SP can be reached at 5,000 BHP and a duty of 413,000 CFM at 69 ins. SP can be reached at 5,750 BHP.

We also include, for reference, the test results summary sheet originally faxed to you 12/10/91.

We hope the foregoing will allow you to proceed with your evaluation. If you have further questions regarding specific duties or conditions, or relative efficiencies, please let us know.

Regards,

Cecil Ireland

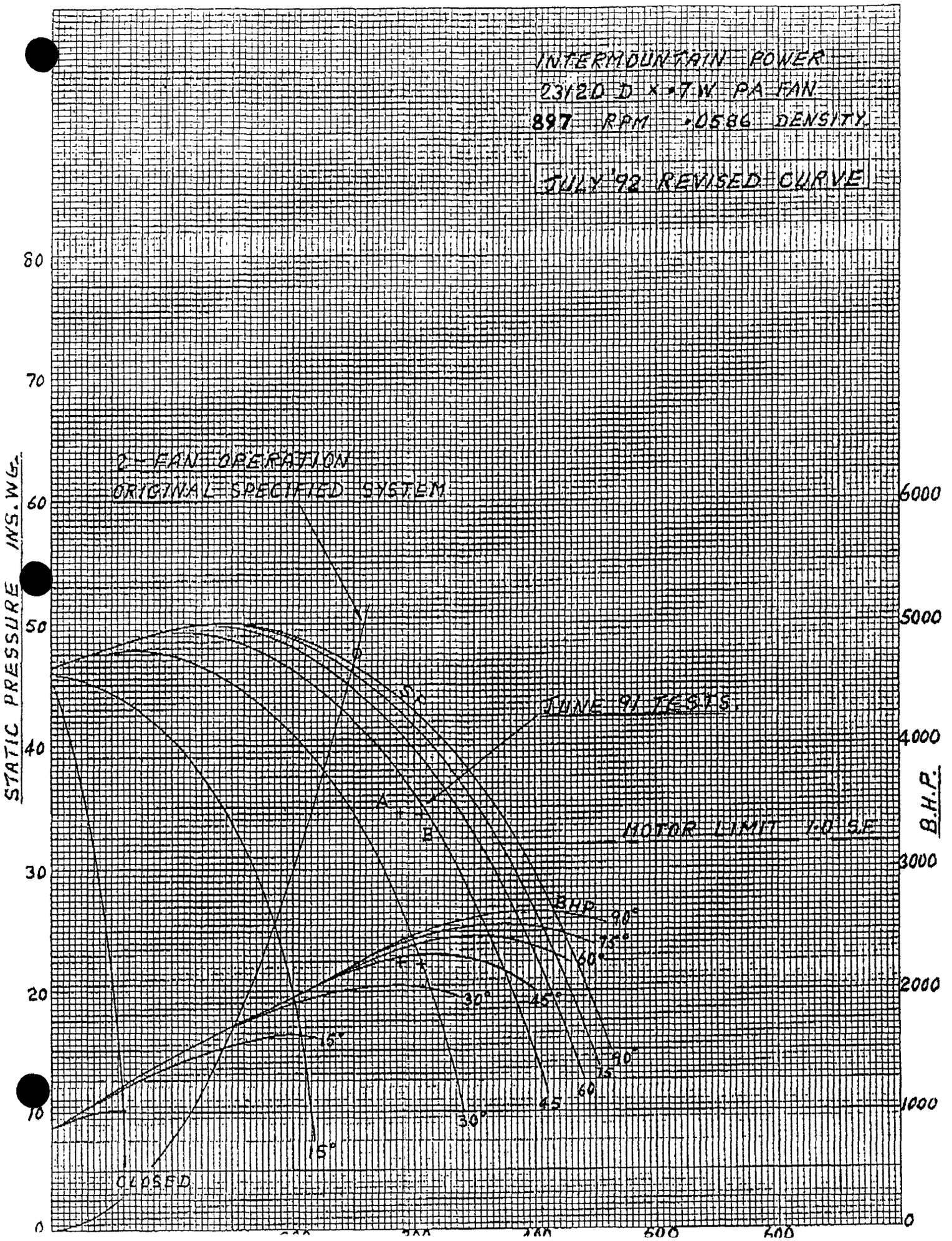
Cecil Ireland

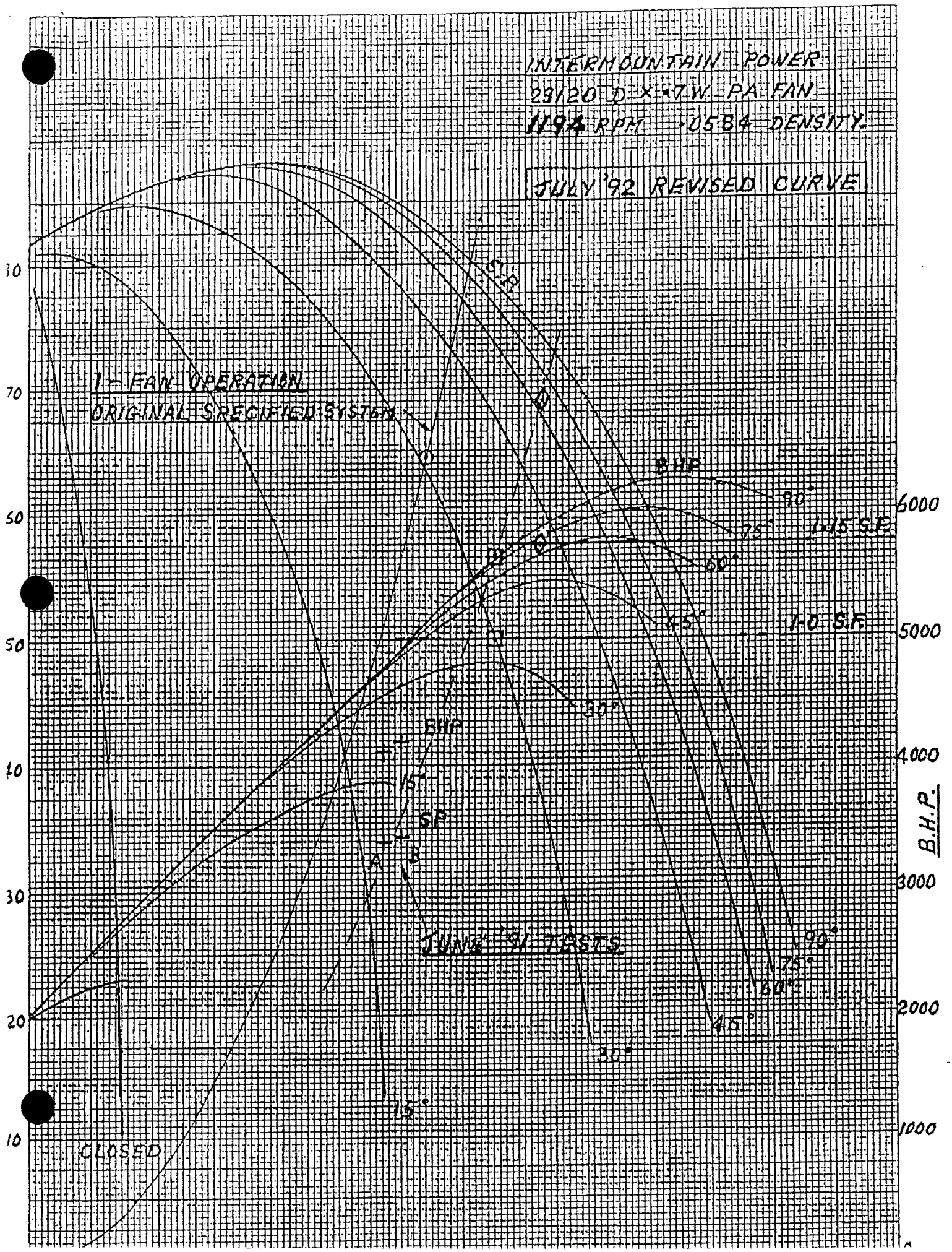
CI/srm-1368E

cc: J. McLaughlin - Aurora, CO
L. Krieger - Aurora, CO
J. Srivastava - Hyde Park, MA
J. Sharer - Hyde Park, MA

Enclosures:

(Total pages faxed: 5


INTERMOUNTAIN POWER
23120 D x 7W PA FAN
897 RPM .0586 DENSITY
JULY '92 REVISED CURVE
2-FAN OPERATION
ORIGINAL SPECIFIED SYSTEM
JUNE 91 TESTS
MOTOR LIMIT 1.0 S.F.
STATIC PRESSURE INS. WG.
B.H.P.
BHP
CLOSED
90°
75°
60°
45°
30°
15°
0
80
70
60
50
40
30
20
10
0
6000
5000
4000
3000
2000
1000
0
600


INTERMOUNTAIN POWER
23/20 D X-7W PA FAN
1194 RPM .0584 DENSITY
JULY '92 REVISED CURVE
1- FAN OPERATION
ORIGINAL SPECIFIED SYSTEM
STALL
BHP
90°
75°
60°
45°
1-15 S.F.
1-0 S.F.
BHP
15°
SP
A
B
JUNE '91 TESTS
90°
75°
60°
45°
30°
15°
CLOSED
B.H.P.
6000
5000
4000
3000
2000
1000
70
50
50
40
30
20
10

SIROCCO INC. One Westinghouse Plaza Hyde Park, MA 02136

TEST SUMMARY (RAW DATA)

SIDE	TP IN "WG	VP IN "WG	SP IN "WG	SP OUT	BAR.	To	Tw	TIN	TOUT	RPM
DRIVE	-.619	.4502	-1.578		25.41	72	54	67.3		898
OUTBOARD	-.463	.376	-.803	37.05	25.40	64	51	67.7	99.8	897
DRIVE		.4414	-.9903		25.41	65	46	64.8		1194
OUTBOARD	-.4837	.376	-.6958	36.53	25.40	63	51	68.17	114.7	
DRIVE	-.5113	.4671	-.6156		25.44	65	46	66.3		
OUTBOARD	-.586	.4766	-.7895	37.05	25.45	65	46	66.4	93.6	897
DRIVE	-.579	.4565	-.6022		25.47	70	49	75.2		
OUTBOARD	-.593	.447	-.749	36.734	25.46	69	49	69.4	118.6	

TEST SUMMARY (RESULTS CONVERTED TO CURVE CONDITION)

LOW SPEED FAN 2A

287515 CFM 34.64 "WG 55.5° VANES 2241 HP

HIGH SPEED FAN 2A

285496 CFM 33.98 "WG 75° VANES 4116 HP

LOW SPEED FAN 2B

306219 CFM 34.44 "WG 54.5° VANES 2238 HP

HIGH SPEED FAN 2B

300566 CFM 34.2678 "WG 74.5° VANES 4187 HP

Wm. G. Ireland.

6481

FAX TRANSMITTAL

TO: John CHRISTENSEN

COMPANY: INTERMOUNTAIN POWER CO.

FAX# 801-864-4970

FROM: WES COLBERT

COMPANY: POWELL-ESCO COMPANY
P.O. BOX 1039
GREENVILLE, TX 75403
PHONE# 903-455-6234
DALLAS: 214-442-7641

FAX# 903-455-3807

SUBJECT: 400 Amp 5 SPEED CHANGER SWITCH

DATE: 5-15-92

NO OF PAGES: 1

John The 400 Amp RATED SWITCH WILL OPERATE AT 440 Amps CONTINUOUS LOAD WITH NO EFFECT ON THE UNIT.

Mac

DEPARTMENT OF WATER & POWER
OF THE CITY OF LOS ANGELES
POWER SYSTEM

(801) 864-4970

IPP

058175

POWER DESIGN AND CONSTRUCTION DIVISION
QUALITY ASSURANCE OFFICE

CONTRACT/JOB 9255.62.3401-Unit 2 Boiler Units for IPP MEP XB-8-4599 AFE PAU37

CONTRACTOR Babcock & Wilcox LOCATION Anaheim, CA

SUBCONTRACTOR/FOREMAN Westinghouse LOCATION Round Rock, TX

SPO NOS. _____ ITEMS COVERED _____

ACTIVITY Witness Testing REPORT PERIOD: 5/14 - 23/85 REPORT NO. 91

SUMMARY

Work Progress and Quality

Routine electrical testing was witnessed on two motors for the contract. All test results were satisfactory.

Schedule Status

The motors for the contract are on schedule.

DETAILED REPORT

Persons contacted at the factory included:

Messrs. James Dvorak - Contract Administrator
Don Richmond - Test Engineer
Les Williams - Tester

I was accompanied by Mr. Mark Fenske, QA representative of Babcock and Wilcox for the inspection.

Contract 2010N/62.3401 is for the Boiler Units for IPP. Westinghouse is under subcontract to B & W to build two 4000 HP Motors for the primary air fans for Unit 2 of the Intermountain Power Project. The motors are 2 speed 4000/2100 HP, 6000 volt, 1.0 service factor, 3 phase; with a 80°C temperature rise guarantee.

Routine electrical tests were performed on two motors for this contract: serial #1668AA-01 and serial #1668AA-02

A mechanical vibration test was performed on each of the two motors. The amplitude of vibration was measured on the shaft and housing in both the horizontal and vertical planes with the motors operating at both speeds. The maximum vibration measured in any position was .900 mils. Nema Std. MG1-20.52 specifies a maximum of 2.5 mils for machines with a speed between 1000 and 1499 rpm and a maximum vibration of 3.0 for machines with a speed of 999 rpm or less.

Bearing temperature rise tests were perfomed on both motors at both high and low speeds. The results of the tests at each rating were as follows:

G. Schroeder 6/3/85

QC227

0053 0000 185 0222

IP12_001954

POWER DESIGN AND CONSTRUCTION DIVISION
QUALITY ASSURANCE OFFICE

CONTRACT/JOB 9255.62.3401 - Unit 2 Boiler Units for IPP REPORT NO. 91

Serial #	Ambient Temp. °C	Temperature, °C Rear Bearing	Front Bearing
1668AA-01 (High)	26.6	57.6	61.8
(Low)	26.1	51.4	54.8
1668AA-02 (High)	26.5	58.0	61.9
(Low)	26.0	53.0	56.1

Air gap measurements were taken at four different areas around the perimeter of the motors. All air gap measurements were within the allowed standard tolerance of 5% above the specified gap. The results were as follows:

Serial #1668AA-01

	1	2	3	4	Specified Air Gap (in)
Front (in.)	.090	.095	.095	.095	.102 (max.)
Rear (in.)	.095	.095	.095	.090	.102 (max.)

Serial #1668AA-02

	1	2	3	4	Specified Air Gap (in.)
Front (in.)	.090	.100	.095	.100	.102 (max.)
Rear (in.)	.100	.095	.100	.100	.102 (max)

The locked rotor current at reduced voltage was measured for each motor for both ratings. From the locked rotor saturation-curve the current at rated voltage was calculated. The test results were as follows:

	Locked Rotor Currents (amps) Reduced V	100%V	Guarantee (100%)
Serial #1668AA-01			
High Speed	1456	1948	1970
Low Speed	1259	1453	-
Serial #1668AA-02			
High Speed	1453	1942	1971
Low Speed	1261	1443	-

Sound pressure level tests were performed on one motor (s/n 1668AA-02) and the octave band level test on 1668AA-01. The results were as follows:

G. Schroeder 6/3/85

DC737

POWER DESIGN AND CONSTRUCTION DIVISION
QUALITY ASSURANCE OFFICE

CONTRACT/JOB 9255.62.3401 - Unit 2 Boiler Units for IPP REPORT NO. 91

Serial #1668AA-01 (4000HP) (db)

Average Sound Pressure Level @ 6600V

Octave Bands (HZ)	Actual	Corrected	Ambient	Guarantee
125	76.5	73.5	72.9	90
250	79.1	77.1	74.9	87
500	77.3	75.3	71.8	85
1K	74.2	74.2	71.4	85
2K	75.2	74.2	65.9	85
4K	69.3	68.3	60.7	85
8K	60.5	60.5	50.7	85
"A" Scale	80.7	78.7	74.9	85

Serial #1668AA-01 (2100HP) db Levels

Octave Bands (HZ)	Actual	Corrected	Ambient	Guarantee
125	76.6	74.6	72.9	90
250	77.3	74.3	74.3	87
500	73.3	73.3	71.6	85
1K	73.4	73.4	71.3	85
2K	72.2	71.2	65.8	85
4K	61.3	61.3	60.3	85
8K	51.0	51.0	50.5	85
"A" Scale	77.9	74.9	74.9	85

Serial #1668AA-02

Rating	A-Scale db	Corrected	Ambient	Guarantee
4000 HP	81.2	80.2	74.2	85
2100 HP	78.0	75.0	74.7	85

The high potential and polarization index tests were witnessed on both motors. The polarization test was performed at a voltage of 8250 vdc. At the end of the ten minute period the resistance ranged from 82,500 megohm for 1668AA-01 to 57,750 megohm for 1668AA-02. Each phase of the motors was tested at dry bulb temperature of 23.0°C and 24.5°C.

Corrected to 40°C, the average insulation resistance was roughly 28,050 megohm for 1668AA-01 and 19,900 megohm for 1668AA-02

The polarization indices ranged from a low of 5.0 to a high value of 6.36. The required minimum index needed for class B insulation according to IEEE standard 43 is 2.0.

G. Schroeder 6/3/85

DC937

POWER DESIGN AND CONSTRUCTION DIVISION
QUALITY ASSURANCE OFFICE

CONTRACT/JOB 9255.62.3401 - Unit 2 Boiler Units for IPP REPORT NO. 91

High potential tests were witnessed on both motors. Each stator was subjected to 14.2KV for one minute; each RTD withstood 1500V for one minute; and each space heater received 1200V for a minute. All test results were satisfactory.

With the successful completion of all required tests the motors have been sent to be painted and prepared for final inspection.

GHS:cem
cc: James H. Anthony
R. L. Nelson
R. J. Clark - 4
IPP File
R. W. Dutton

G. Schroeder 6/3/85

DC237

Doc. No. 1022701

ENGINEER'S COPY

Babcock & Wilcox
a McDermott company
CDJ
EDC
FYI ⇒ WRM
AEN
JKH
JPC
RET TO JHN

91 000051 BH

Suite 410
7401 West Mansfield Avenue
Lakewood, CO 80235
(303) 988-8203

February 22, 1991

Mail Engr. Section
FEB 27 1991

Department of Water & Power
City of Los Angeles
111 N. Hope Street
Los Angeles, CA 90051

Attn: J.W. Scofield

Re: Intermountain Power Project
B&W Contract RB-614/615

Dear Mr. Scofield:

The following is a listing of final warranty items for the Intermountain Power Project. With each item is a discussion of current status and proposed actions.

1. Pulverizer Variable Loading System: The previously quoted 24 months delivery was in error, 24 weeks is correct. A quote for an additional unit for a spare and for start-up service has been submitted. We should be able to proceed immediately upon receipt of a change order.

2. Merrick Coal Feeders: Problems reported with calibration and maintenance were corrected last fall on Unit 2. The service representative for Merrick was the most knowledgeable to date, and we are working to have the same representative for Unit 1 this spring.

3. Bailey Control System Grounding: An acceptable strategy for isolating the system has been developed by Bailey and approved by IPSC. We are unable to mobilize by outage time for Unit 2, but we have scheduled Bailey to do Unit 1 on the upcoming outage. We will schedule Unit 2 for the fall.

4. Burner Line Fires: We have offered to assist IPSC with clean and/or dirty air tests to resolve this problem. We are awaiting schedule information from IPSC.

5. Automation of Pulverizer Clearing: We are presently developing a specification from our design group's recommendation. We will then provide a quote for performing this work for your review.

6. Safety Valves: Ring pin breakage continues to be a problem, and response from Dresser has been disappointing to date. We will continue to press Dresser for a solution, and are soliciting help from our Purchasing Department.

7. Sootblower Panel: We are in contact with Diamond Power to determine requirements for implementation of the recommendations in Frank Merritt's November 19, 1989 report. We will advise our findings upon receipt.

8. Economizer Tube Rubbing: As a final confirmation, we will UT a selected sample of tubes on Unit 1 during this upcoming outage. It is expected that no wear will be detected and this issue will be closed.

9. Spacer Bars: We are adding the new spacer bar design to the rear of the reheater intermediate section on Unit 2, this outage. On Unit 1, both the secondary superheater outlet bank and reheater intermediate bank (rear) will be completed during the next outage.

10. Burners: Inspections by our burner expert will be conducted during the outages. Based on observations of Unit 2 last fall, we expect few, if any, problems with burner deterioration. Also, we have reviewed the "consultants" remaining life report and feel many of the recommendations are unwarranted. However, we are conducting a design review of the burners and will wish to review this with you and your staff in the near future.

11. Support Castings: We will continue visual inspections of the RH support castings on Unit 1 for the duration of the warranty. At the same time, we are developing an engineering review to determine if further improvements in the design and/or repair procedure can be made. This information will be forwarded as it becomes available.

12. Air Preheaters: Discussions with Bruce Corey indicate that he is still prepared to meet with DWP and IPSC to discuss IDS upgrades and other outstanding issues. This will be coordinated with Krikorian.

13. PA Fan Performance: The review of test data by Barberton design has been completed and a report is being prepared. It appears that motors with a higher service factor would result in the desired capacity. This report will be forwarded under a separate cover when completed.

This represents the known warranty obligations. Should you have questions or comments, please advise.

Very truly yours,

BABCOCK & WILCOX COMPANY

D.C. Langley
Regional Service Manager
Western Region

DCL:pm
326

Babcock & Wilcox
a McDermott company

To	D.C. LANGLEY, REGIONAL SERVICE MANAGER WESTERN REGION
From	J. WM. SMITH - MGR., DESIGN ENGINEERING BVCB1G
	BDS 663-8
Cust.	INTERMOUNTAIN POWER PROJECT
File No. or Ref.	RB-614
Subj.	PRIMARY AIR FAN MOTOR
Date	NOVEMBER 13, 1991

This letter to cover one customer and one subject only.

Judging from the data available, we believe that the primary air fan is performing near its predicted fan curve and that the motors are undersized. The causes of the present condition are primarily a faulty fan sizing logic required by Black & Veatch and failure of B&W to recognize the impact on the fan motor of the silencer strategy change in 1983. If the customer's desire is to prevent the motors from limiting the fan capability, the motors should be replaced to provide the capability of 2700 hp at the low speed condition.

The following observations are made in support of these conclusions:

1. In 1983, the silencing and fan enclosure strategy was changed to provide a fan enclosure room with face heating coils, to delete the steam coil air heater and to provide silencers at the fan inlet and outlet as opposed to silencers at the inlet and in the tempering duct with acoustic insulation and lagging provided in the duct to the air heater. The results of these changes was an increase in low speed test block HP from 2061 to 2217. The motor size (2100 hp) was not changed so the installed motor capacity is now less then the fan test block requirement.

2. The original fan specifications required test block factors of 25% on weight, 50% on pressure and 25°F on temperature. These factors are greater than B&W's typical (for trisector) of 25% on weight and 30% on static and results in a fan efficiency that is unattractive in the normal operating range. To improve efficiency, the customer directed to us to provide a 2-speed motor (900 rpm and 1200 rpm) with the fan selected to provide nominal test block margins at the low speed condition. These were defined by the customer as 10% on flow and 5% on volume. Since fan pressure varies with the square of the flow, the effect was to provide a fan with a near 80% margin on pressure when operated at the high speed condition. This yields a fan with an even more unattractive efficiency characteristic at the high speed operation resulting in the operators perception that the high speed only consumes high HP power while offering little operating advantage.

The low test block margins dictated for the low speed condition removed some of the normal safeguard in equipment selection and contributed to the undersized motor. The test block margins have several purposes. First, they allow for variations in systems performance from the design conditions; this especially becomes important with regenerative air heaters (especially trisectors, which is why the B&W test block is larger when trisectors are used) where the air heater leakage can be an illusive item. Secondly, they provide some margin for deviation of the fan from its predicted performance. Finally, and not insignificantly, the result of the test block factors is to provide a near 60% (1.25 x 1.30) margin on the motor size as compared to the predicted or net condition. With the normal type of test block factors, one is fairly assured that the motor will be adequately sized for rather significant deviations in operating conditions and fan performance. With the reduced factors of 10 and 5%, this inherent margin was eliminated and this fact was not recognized in the motor selection.

The use of the 2-speed motor has little application for a primary air fan. The only value is to potentially provide some economy of power for cases where a wide range of operating pressure requirements might be expected due to both system characteristics and design (test block) margin desires. The primary air system, however, has a characteristic of nearly consistent pressure at maximum mill loading regardless of the number of mills in operation. The 2-speed fan is not appropriate for this application. A more appropriate design would be a variable speed system, but at the time of this offering such systems, I believe, were limited to hydraulic coupling which would probably be deemed undesirable by the customer. Today variable speed electric drives would be an attractive choice for this application for a customer sensitive to auxiliary power consumption. At the time of this proposal, the single speed fan with inlet vane control and a test block margin closer to B&W's recommendation would have been a better choice.

3. B&W's intent was to size the motor based on the low speed test block and not high speed conditions. The low speed power is essentially set on the fan curve with the vanes wide open. The high speed power was set based on vane throttling to the specified test block condition rather than to the 100% vanes open condition and test block flow. The high speed condition at test flow and inlet vanes full open would produce approximately 85 inches pressure (well above the test block) and require a 5000 hp motor (not the 4700 referenced by Black & Veatch). The Black & Veatch suggestion that the high speed power capability is wrong is in error as the motor was designed for the test block conditions. A 5000 hp motor selection would have significantly increased the system cost and lowered the operating efficiency, both to the detriment of the customer.

4. The first fan tests in January 1989 were conducted at the high speed condition. These tests were good in that they measured the air flow at the fan discharge. However, since they were at the high speed condition, they do not address the issue of low speed power. They do demonstrate the poor efficiency resulting from the 2-speed study.

5. The tests conducted in August of 1990 were at the low speed condition. Rather than the detailed traverses to measure the fan discharge flow, the primary air flow to the mills was utilized requiring an assumption of air heater leakage. Note that with the high discharge pressure, the air heater leakage would have been higher than predicted. The measured power is in the range of 2500 hp. Applying a correction to both static pressure and power prediction based on the difference between test conditions and fan test block conditions (the corrections being based on ratio of absolute temperature) and allowing for some uncertainty in the estimation of primary air flow and pressure measured by magnahelic gages, leads me to conclude that the fan is operating near the predicted performance.

   The earlier Functional Engineering analysis did not include the temperature correction and was based on use of the wrong fan curve (the performance prior to the silencer change). The fan curve marked with these corrections is attached. The missing bit of information from this test is the inlet vane position; this information was not recorded and Service does not recall the position. If the vanes were near 100% open, the system appears to be performing as predicted.

6. I did not research the files to determine the basis of the net performance requirements. At both the 60% load and 100% load conditions, the analysis should have considered both the maximum and minimum of mills in service at that point. In addition, the analysis should have considered load points near those conditions with pulverizers at maximum rating and at minimum rating. Note that as the number of mills in service increases at any load, the flow requirements rise and the pressure requirements fall moving to a higher HP requirement on the fan curve.

   The fan predicted performance is such that at the low speed 100% vane position the HP peaks at approximately 2600. I would recommend that the motor be sized at this condition, thus assuring that the motor will not limit the fan performance. Including provision from ambient variation, a 2700 hp motor would be appropriate.

7. The August 1990 test indicate a high fan pressure rise as compared to the predicted performance. Unless the test was set up to run with fully open inlet vanes and throttle at the pulverizer, it would be well to investigate normal operating condition to determine if this high pressure rise is typical and investigate the potential for reducing system pressure. One area of investigation would be the control strategy for the hot and cold air dampers to the mills. Is unnecessary throttling being done at this location? Another area of investigation would be the control strategy for primary air fan discharge pressure. Is the control set point set unnecessarily high resulting in the high fan pressure? To minimize operating power, the discharge pressure should be controlled as a function of pulverizer loading rather than held to a arbitrary high value.

JWS:jw
jws07

cc: H. R. Patel/BVSO2D
E. L. Wells/BVSW2C

PA Fans

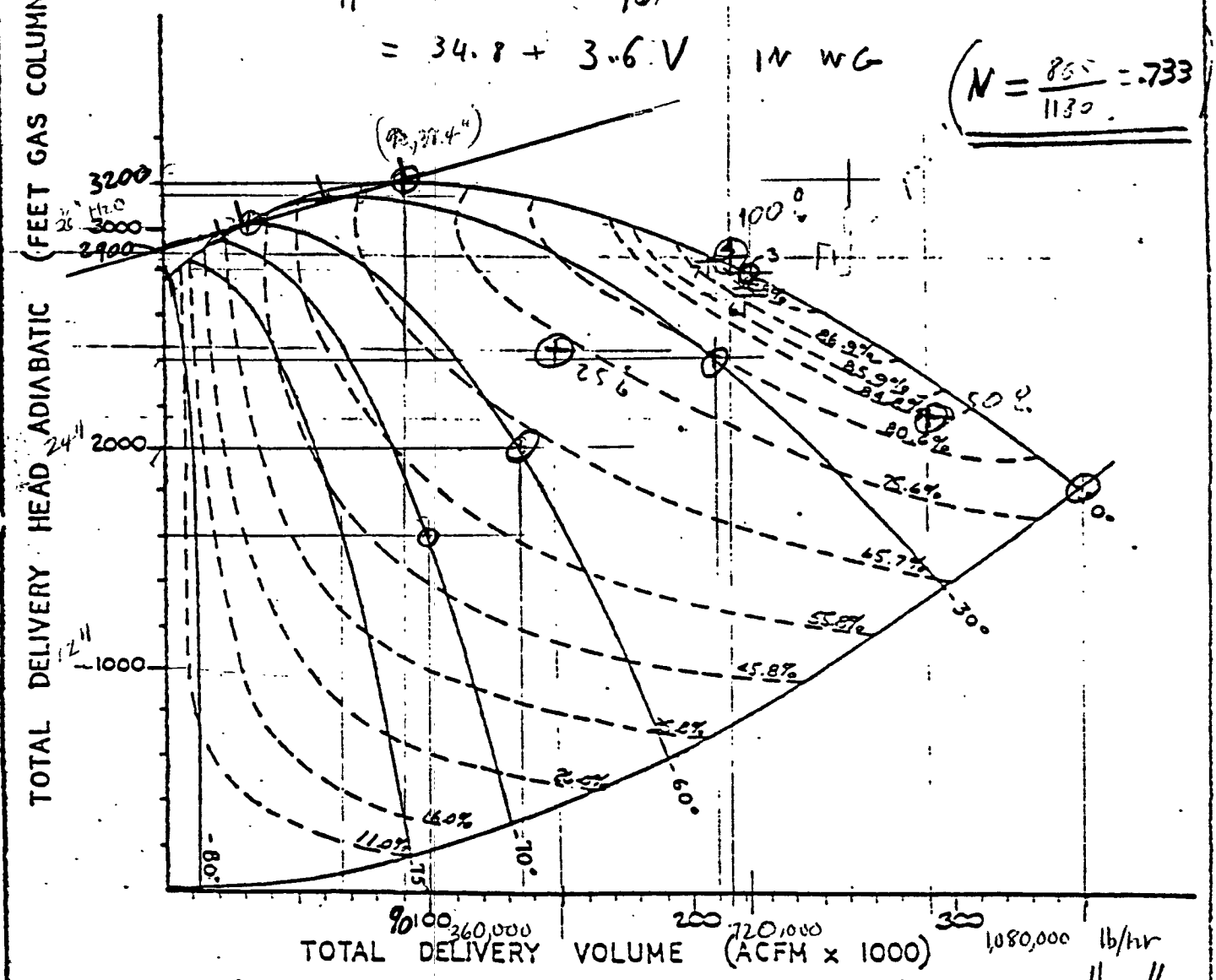
PREDICTED PERFORMANCE

$$W_M = \left(1 - \frac{i}{90}\right) \cdot 90000 \text{ acfm} = V \cdot 324 \times 10^3 \text{ lbm/hr}$$

$$H_M = 2900 + \left(1 - \frac{i}{90}\right) \cdot 300 \text{ ft}$$

$$= 34.8 + 3.6\,V \text{ IN WG}$$

$$\left(N = \frac{865}{1130} = .733\right)$$



DESIGN POINT:

acfm * 3.6 = lbm/hr
ft * .012 = IN WG

VOLUME	a.c.f.m.	EFFICIENCY	%
HEAD	ft. gas	SPEED 865	r.p.m.
TEMPERATURE	°F	HORSEPOWER	BHP.

SECOND SPEED

TLT-BABCOCK, INC.	FAN SIZE 2118AZ/1334 PROP. BR-0516	
	Seperate AH Arrangement	DATE:
		PAGE:

for generic Dit FANS

PRIMARY AIR FLOW TRADEOFFS

Performance Aspects: (original design intent)	Operational Aspects: (real world stituation)
STATUS:	
• PA Duct Press 35-37 "wc	• PA Duct Press 42-44 "wc
• PA Damper Posit 80-95 %	• PA Damper Posit 70-80 %
• PA Fan Current 175-180 amps	• PA Fan Current 180-190 amps
ADVANTAGES:	
• minimize PAH leakage	• improves pulverizer and burner operation
• minimize PA Fan horsepower requirements	
DISADVANTAGES:	
• problems with pulverizer and burner operation	• increases PAH leakage which increases PA flow and PA Fan horsepower and reduces boiler performance
• decreases pulv velocity (inc rejects and fallout)	• increases PA Fan horsepower due to increase in PA duct pressure (head)
• decreases burner line vel	

VARIABLES:
- PA flow and temperature requirements
- coal moisture content
- pulverizer wear

PROBLEM:
- PA Flow controlability, run out of damper position (i.e. run out of air flow and starve pulv of air requirements)

CONCERNS: (inadequate primary air flow)
- Pulverizer- loads up (inc rejects, inc pulv amps, inc press drop, dec fineness)
- Pulverizer Rejects Fire
- Burners- decrease line velocities
- Burner Line Fires

COMPROMISED OPERATION: (based upon discussions with Technical Services and Operations)
- increase Prim Air Duct Press (4 "wc) 37"wc to 41 "wc

ROOT PROBLEM:

- Marginally designed PA Fan Motor
  - -no compensation for motor and drive efficiency
  - -no cushion margin for PA Fan efficiency
  - -no service factor margin

- Problem with high speed operation
  - -cannot get capacity at high speed
  - -electrical: power factor, harmonics, wiring configuration
  - -mechanical: inlet vane control

RESOLUTION:

- Interim- Controls enhancement to allow biasing of individual pulverizers

- Modification- Capital Project PA Flow temperature compensation

- Identification as Boiler Contract Deficiency List

Motor Current Rating Summary List

Description (motor manufactor) Critical Motors:	# of Equip	Operating Mode	HP Rating (HP)	Motor Amp Nameplate Rating (Amp)	Service Factor Amp Rating (Amp)	Relay Protection Alarm Value (Amp)	Maximum Stator Temp (C/F)	Service Factor
Primary Air Fans (Westinghouse)	2	Low Speed	2100	183	183	240	130/266	1.00
		High Speed	4000	302	302	320		
Forced Draft Fans (Westinghouse)	2	Low Speed	2750	275	316	384	140/284	1.15
		High Speed	6500	508	584	640		
Induced Draft Fans (Westinghouse)	4	2nd Link	7415	400 ea	400 ea	--	120/248	1.00
		1st Link	4596	506	506	--	145/293	
Pulverizers (Siemans-Allis)	8	--	800	73	73	80	150/302	1.00
Standby Boiler Feed Pump (Westinghouse)	1	--	7000	512	588	640	140/284	1.15
Booster Boiler Feed Pumps (Reliance Electric)	3	--	600	46	53	64	120/248	1.15
Condensate Pumps (Westinghouse)	3	--	1750	132	152	160	140/284	1.15
Circulating Water Pumps (Siemans-Allis)	3	--	2050	179	206	192	120/248	1.15

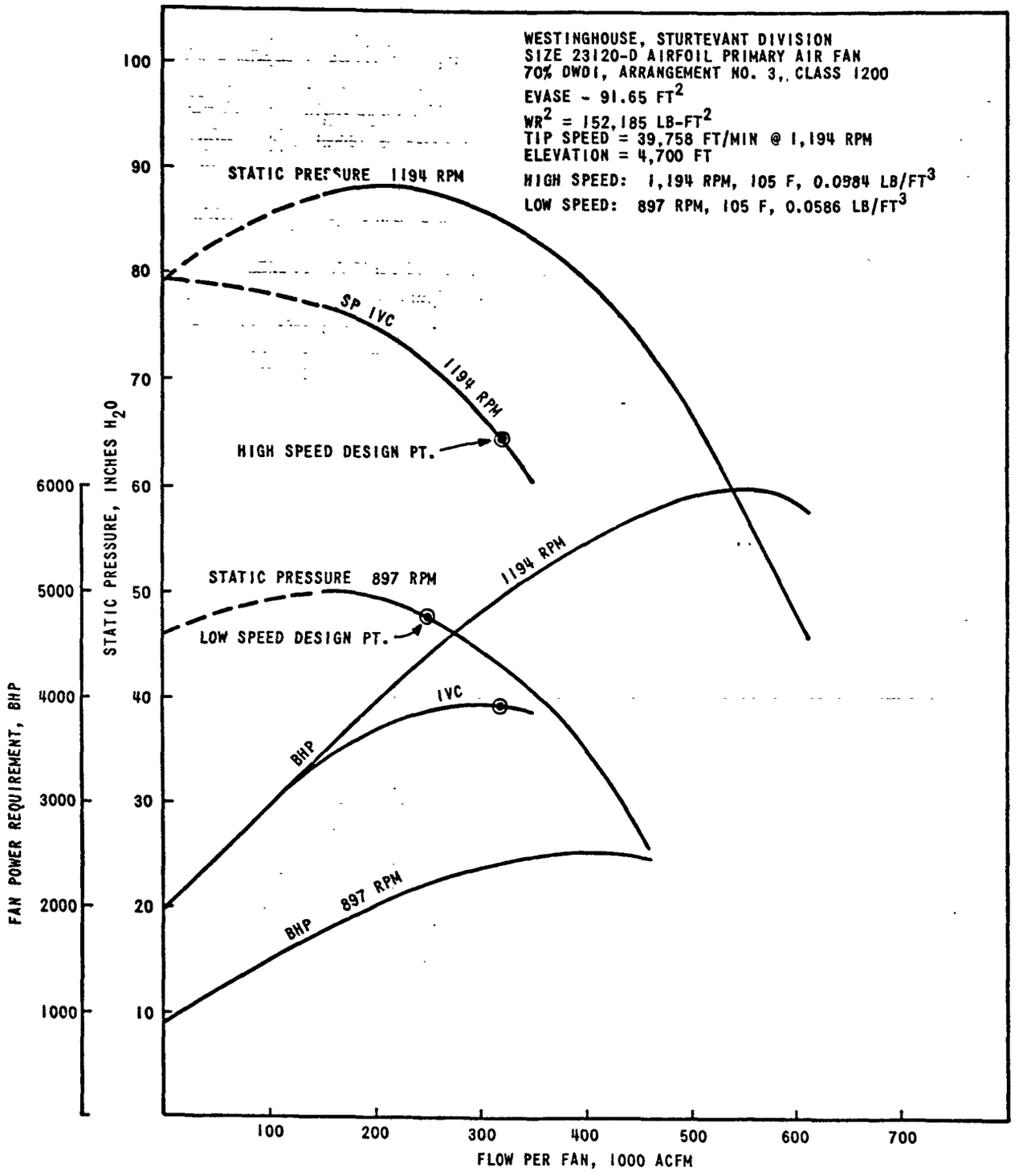
Notes:

1. The service factor current rating allows continuous operation of the motor at the nameplate current rating multiplied by the service factor. This operation shall maintain a stator temperature below the limiting temperature value.

2. The relay current alarms are listed because some alarm values are lower than the service factor current rating. These relay protection alarm values can be exceeded up to the maximum service factor current rating.

TABLE 3-2. PRIMARY AIR FAN PREDICTED PERFORMANCE

Item	Test Block	MCR
Inlet Air Temperature, F	105	105
Inlet Air Density, lb/ft^3	0.0588	0.0588
Capacity, each fan		
Pounds per hour	1,120,300	882,000
Actual cfm	317,500	250,000
Fan Static Pressure, in. wg	62.5	44.5
Fan Static Efficiency, per cent	81.9	84.9
Design Fan Speed, rpm	1,194	897
Input Horsepower	3,810	2,061



IVC - Inlet Vane Control

PRIMARY AIR FAN STATIC PRESSURE AND HORSEPOWER PERFORMANCE CURVES
FIGURE 3-6

each rotating shaft and complying with the requirements of the State of Utah shall be furnished for each coupling of each fan. The coupling guard shall be provided with a removable plate or other equivalent means for inspection and oiling.

21.8 Sole Plates: Steel sole plates for each fan bearing pedestal shall be provided. Bearing pedestals shall be bolted to the IPA foundation by means of anchor bolts extending through the sole plates.

21.9 Primary Air Fans: Primary air fans shall be provided as necessary for proper boiler operation. With one primary fan out of service the remaining fans shall be capable of providing sufficient primary air to permit boiler operation up to not less than 60 percent of Maximum Capacity with each of the specified coals. Test block performance of each fan with inlet boxes and silencers shall be greater than its expected operating performance by not less than 25 percent for weight flow, not less than 50 percent for static discharge pressure, and not less than 25F for temperature at the plant's elevation for each of the specified coals.

The primary air fans shall be of the full shrouded type with backwardly curved airfoil blades and shall be double width, double inlet. The fans shall have inlet boxes complete with silencers. An annubar and 2 thermocouples shall be provided in each inlet box for measuring the primary air flow.

The bearings shall be of the self-aligning, split sleeve type capable of withstanding high thrust loads due to any unbalanced forces on the fan wheel. The bearings shall be cooled with oil from the lubricating oil package specified herein. The bearing lubrication system shall be of the flow-through flood type.

An independent lubricating oil package shall be furnished for each fan and motor unit. Each lubricating oil package shall be capable of supplying the required amount of lubricating oil to the fan and motor bearings at test block conditions.

Each package shall be complete with dual full-capacity water-to-oil heat exchangers, dual full-capacity oil filters, and dual full-capacity pumps and motors. The filter shall be cleanable or replaceable without interrupting the oil flow. The complete package shall be factory-wired, assembled, and mounted on a common base. The packaged system shall be arranged and wired such that either pump may serve as the main supply pump while the other pump serves as the standby pump.

	Hybrid		Constant Pressure				
Load.....percent of Maximum Capacity	25	50	25	50	75	100	105
Power input to motors:							
Number of pulverizers operating.....	2	5	2	5	6	7	7
Pulverizer motors.....kW	886	1904	876	1886	2494	3048	3152
Number of primary air fans operating.....	1	1	1	1	2	2	2
Primary air fan motors.....kW	1098(.920)	1341(.935)	1058(.920)	1325(.935)	2132(.933)	2447(.934)	2549(.935)▲
Number of coal feeders operating.....	2	5	2	5	6	7	7
Coal feeder motors.....kW	3	8	3	8	10	11	11*
Number of boiler circulation pumps operating.....	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Boiler ciculation pump motors.....kW	N/A	N/A	N/A	N/A	N/A	N/A	N/A
All other motors.....kW	103	128	103	128	133	138	138**

* Based on Merrick Feeders

** Seal Air Fans and Regenerative Air Heaters
(Two 24-I/2 VI 44 Primary and Two 33-1/2 VI 64 Secondary's)

▲ Westinghouse Two Speed Fans (23120D) with Two Speed Motors.

( ) Indicates Expected Motor Efficiency

	Based on 7 Mills in Operation	
	Coal Reserve B and F*	Coal Reserve F
Boiler efficiency.....percent	88.82	87.07
Total pressure loss from the air heater air inlet to the furnace.....in. of water	5.3	5.4
Total pressure loss from the furnace to the air heater flue gas outlet.....in. of water	8.3	8.8
Excess air at the economizer outlet.....percent	17	17
Excess air at the air heater gas outlet.....percent	26	26
Dust loading in the flue gas leaving the economizer.....grains/scf	5.21	3.96
Capacity with only 2 pulverizers in service.....percent Maximum Capacity	30	29
Capacity with only 2 pulverizers cut of service.....percent Maximum Capacity	100	97
Air flow rates:		
Theoretical air for combustion....Mlb/hr	5781	5880
Total air for combustion including excess air.....Mlb/hr	6651	6762
Air from primary air fans.....Mlb/hr	1533	1600
Tempering air.....Mlb/hr	246	142
Air from primary air heaters excluding tempering air.....Mlb/hr	1111	1260
Air from forced draft fans.....Mlb/hr	5693	5763
Sealing air, from temperature air duct.....Mlb/hr	77	77
Air to secondary air heaters.....Mlb/hr	5693	5763
Air from secondary air heaters....Mlb/hr	5371	5437

* Mixture of coals from Coal Reserves B and F on an equal weight basis.

	Based on 7 Mills in Operation	
	Coal Reserve B and F*	Coal Reserve F
Air pressures:		
Air from primary air fans...in. cf water	36.8	39.2
Air to primary air heaters..in. cf water	33.9	36.1
Air from primary air heaters.....in. cf water	32.1	34.1
Air to secondary air heaters.....in. of water	5.3	5.4
Air from secondary air heaters.....in. of water	3.1	3.2
Air at windbox.....in. cf water	1.1	1.1
Air temperatures:	155F average air heater cold end temperature required	
Minimum ambient temperature not requiring air preheating.....F		
Air to secondary air heaters.....F	65	65
Air from secondary air heaters.....F	632	628
Air from primary air heaters excluding tempering air.....F	542	536
Air to pulverizers.....F	452	487
Flue gas flow rates:		
Leaving economizer.....Mlb/hr	7456	7627
Leaving primary air heaters.....Mlb/hr	1226	1381
Leaving secondary air heaters.....Mlb/hr	6730	6770
Flue gas pressures:		
Leaving economizer.....in. cf water	-4.3	-4.5
Leaving primary air.....in. cf water	-6.5	-7.2
Leaving secondary air heaters.....in. cf water	-9.3	-9.4

* Mixture of coals from Coal Reserves B and F on an equal weight basis.

MOTOR SLOW SPEED OPERATION

INTERMOUNTAIN POWER UNIT# 2 BACKUP FOX 1/A

REQUESTED
13:04:50 09/16/90

REPORT # 45 PA FANS LOG

1. PA FAN 2A MOT STATOR T
2. PA FAN 2A MOTOR AMPS
3. PA FAN FLOW 2A
4. PA FAN 2B MOT STATOR T
5. PA FAN 2B MOTOR AMPS
6. PA FAN FLOW 2B
7. PA DUCT PRESS
8. GENERATOR 1 WATT XDCR 3
9.
10.
11.
12.

TIME	1 SCBTE0 858 DEGC	2 SCBKK0 007 AMPS	3 COAXI0 74A PCT	4 SCBTE0 859 DEGC	5 SCBKK0 008 AMPS	6 COAXI0 75A PCT	7 COAXI0 72A INWC	8 TGEPK0 022 MW	9	10	11	12
07/08/90												
0: 0: 0	53.85	172.48	20.78	55.67	171.65	23.03	43.02	555.82	.00*	.00*	.00*	.00*
2: 0: 0	51.82	164.15	14.83	51.62	154.15	15.15	43.28	302.34	.00*	.00*	.00*	.00*
4: 0: 0	49.80	164.15	15.65	49.59	154.15	15.02	42.98	301.64	.00*	.00*	.00*	.00*
6: 0: 0	48.78	164.15	15.65	48.58	154.15	15.58	42.96	336.45	.00*	.00*	.00*	.00*
8: 0: 0	48.78	164.15	18.50	48.58	162.48	17.83	43.32	427.85	.00*	.00*	.00*	.00*
10: 0: 0	51.82	189.15	28.03	52.63	187.48	28.30	42.42	809.65	.00*	.00*	.00*	.00*
12: 0: 0	54.86	189.15	28.13	55.67	187.48	29.45	43.10	833.91	.00*	.00*	.00*	.00*
14: 0: 0	55.88	189.15	28.40	56.69	187.48	30.53	42.88	834.96	.00*	.00*	.00*	.00*
16: 0: 0	51.82	189.15	28.43	53.65	187.48	30.42	43.16	834.61	.00*	.00*	.00*	.00*
18: 0: 0	51.82	189.15	29.48	52.63	187.48	30.25	43.00	840.59	.00*	.00*	.00*	.00*
20: 0: 0	51.82	189.15	28.80	53.65	187.48	31.18	43.10	841.64	.00*	.00*	.00*	.00*
22: 0: 0	51.82	198.31	27.70	52.63	196.65	29.85	42.88	836.02	.00*	.00*	.00*	.00*
07/09/90												
0: 0: 0	51.82	189.98	28.00	52.63	188.31	29.62	43.06	772.03	.00*	.00*	.00*	.00*
2: 0: 0	48.78	172.48	20.78	50.61	171.65	22.03	43.36	412.73	.00*	.00*	.00*	.00*
4: 0: 0	46.76	164.15	17.90	45.54	163.32	19.15	43.00	351.91	.00*	.00*	.00*	.00*
6: 0: 0	46.76	164.15	18.98	45.54	163.32	19.23	42.98	382.50	.00*	.00*	.00*	.00*
8: 0: 0	47.77	189.15	28.25	48.58	189.15	30.58	42.88	838.12	.00*	.00*	.00*	.00*
10: 0: 0	50.81	189.15	29.10	50.61	189.15	30.25	43.00	840.23	.00*	.00*	.00*	.00*
12: 0: 0	53.85	189.15	28.43	54.66	189.15	30.25	43.02	840.23	.00*	.00*	.00*	.00*
14: 0: 0	56.89	189.15	28.25	57.70	189.15	30.32	42.98	843.40	.00*	.00*	.00*	.00*
16: 0: 0	59.93	197.48	29.00	60.74	197.48	30.55	42.72	838.48	.00*	.00*	.00*	.00*
18: 0: 0	58.92	197.48	28.15	57.70	197.48	29.33	43.12	843.40	.00*	.00*	.00*	.00*
20: 0: 0	52.63	197.48	28.65	52.63	197.48	29.83	43.12	840.59	.00*	.00*	.00*	.00*
22: 0: 0	50.61	197.48	29.13	52.63	197.48	30.55	42.82	837.77	.00*	.00*	.00*	.00*
07/10/90												
0: 0: 0	49.59	197.48	28.10	51.62	189.15	30.68	43.08	773.09	.00*	.00*	.00*	.00*
2: 0: 0	48.58	180.81	26.15	49.59	180.81	26.95	42.98	773.44	.00*	.00*	.00*	.00*
4: 0: 0	46.55	180.81	25.45	48.58	180.81	27.35	43.16	706.29	.00*	.00*	.00*	.00*
6: 0: 0	45.54	180.81	25.30	45.54	180.81	27.30	42.88	736.52	.00*	.00*	.00*	.00*
8: 0: 0	46.55	189.15	29.00	47.57	189.15	30.23	43.00	838.48	.00*	.00*	.00*	.00*
10: 0: 0	50.61	189.15	28.82	50.61	189.15	30.58	43.02	839.88	.00*	.00*	.00*	.00*
12: 0: 0	55.67	189.15	28.48	55.67	189.15	30.75	43.10	839.88	.00*	.00*	.00*	.00*
14: 0: 0	59.73	199.15	29.45	59.73	195.81	30.32	43.26	841.29	.00*	.00*	.00*	.00*
16: 0: 0	59.73	199.15	28.85	60.74	195.81	29.93	43.02	837.07	.00*	.00*	.00*	.00*
18: 0: 0	61.75	199.15	27.55	62.77	195.81	31.00	43.08	837.07	.00*	.00*	.00*	.00*
20: 0: 0	63.78	197.48	28.70	64.79	203.31	30.18	43.66	839.53	.00*	.00*	.00*	.00*
22: 0: 0	59.73	197.48	28.78	61.75	194.98	30.45	43.02	840.94	.00*	.00*	.00*	.00*
07/11/90												
0: 0: 0	56.69	197.48	28.90	58.71	194.98	31.70	43.06	841.99	.00*	.00*	.00*	.00*
2: 0: 0	55.67	197.48	27.98	57.70	194.98	30.42	43.28	837.42	.00*	.00*	.00*	.00*
4: 0: 0	53.65	197.48	28.95	54.66	194.98	31.23	42.90	838.48	.00*	.00*	.00*	.00*

14112 G.B.

IP12_001975

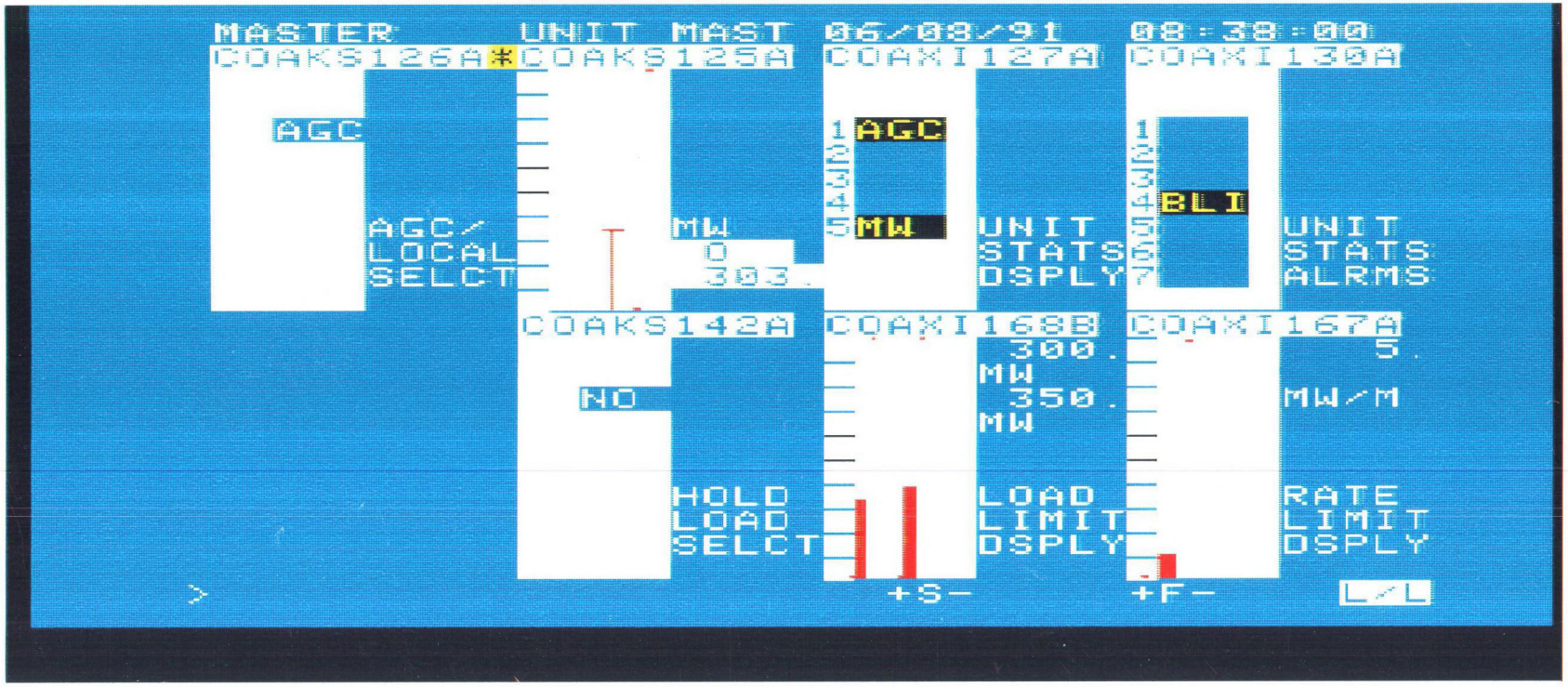
REQUESTED
14:33:33 08/16/90 PAGE 001

REPORT 6 PA FAN LOG

1. PA FAN 2A MOT STATOR T
2. PA FAN 2A MOTOR AMPS
3. PA FAN FLOW 2A
4. PA FAN 2B MOT STATOR T
5. PA FAN 2B MOTOR AMPS
6. PA FAN FLOW 2B
7. PA DUCT PRESS
8. GENERATOR 1 WATT XDCR 3
9.
10.
11.
12.

TIME	1 SGBTEO 858 DEGC	2 SGBKKO 007 AMPS	3 COAXIO 74A PCT	4 SGBTEO 859 DEGC	5 SGBKKO 008 AMPS	6 COAXIO 75A PCT	7 COAXIO 72A INWC	8 TGBPKO 022 MW	9	10	11	12
08/08/90												
12: 0: 0	61.45	194.98	28.78	61.35	195.81	30.75	43.02	839.18	.00*	.00*	.00*	.00*
14: 0: 0	65.50	194.98	28.25	65.40	195.81	30.40	43.00	839.88	.00*	.00*	.00*	.00*
16: 0: 0	66.52	185.81	26.18	66.42	187.48	27.98	43.02	842.34	.00*	.00*	.00*	.00*
18: 0: 0	66.52	194.15	27.30	67.43	187.48	29.28	42.90	839.53	.00*	.00*	.00*	.00*
20: 0: 0	66.52	194.15	29.02	67.43	195.81	30.58	42.82	842.70	.00*	.00*	.00*	.00*
22: 0: 0	64.49	194.15	27.62	66.42	195.81	31.12	42.90	839.53	.00*	.00*	.00*	.00*
08/09/90												
0: 0: 0	63.48	194.15	27.88	63.38	195.81	30.58	43.26	841.99	.00*	.00*	.00*	.00*
2: 0: 0	59.42	194.15	27.67	59.32	187.48	30.68	43.00	838.83	.00*	.00*	.00*	.00*
4: 0: 0	55.37	184.98	24.55	56.28	179.15	26.40	42.92	751.99	.00*	.00*	.00*	.00*
6: 0: 0	52.33	184.98	24.75	52.03	179.15	27.20	42.88	768.87	.00*	.00*	.00*	.00*
8: 0: 0	54.36	193.31	27.83	55.07	187.48	30.87	43.18	838.83	.00*	.00*	.00*	.00*
10: 0: 0	57.40	193.31	27.50	58.11	187.48	29.50	43.00	838.48	.00*	.00*	.00*	.00*
12: 0: 0	61.45	193.31	27.65	62.16	187.48	30.18	43.06	842.34	.00*	.00*	.00*	.00*
14: 0: 0	64.49	193.31	28.05	64.19	195.81	30.00	43.06	840.59	.00*	.00*	.00*	.00*
16: 0: 0	65.50	193.31	28.82	66.21	195.81	29.85	43.00	841.99	.00*	.00*	.00*	.00*
18: 0: 0	66.52	193.31	28.40	67.23	195.81	30.37	43.02	839.88	.00*	.00*	.00*	.00*
20: 0: 0	65.50	193.31	27.52	66.21	195.81	29.85	43.02	839.88	.00*	.00*	.00*	.00*
22: 0: 0	63.48	194.15	28.22	64.19	195.81	29.83	43.00	839.53	.00*	.00*	.00*	.00*
08/10/90												
0: 0: 0	60.44	194.15	28.10	61.15	195.81	30.25	43.00	839.18	.00*	.00*	.00*	.00*
2: 0: 0	56.38	185.81	25.28	58.11	179.15	26.70	44.12	660.59	.00*	.00*	.00*	.00*
4: 0: 0	54.36	177.48	22.03	54.05	170.82	23.18	43.02	593.09	.00*	.00*	.00*	.00*
6: 0: 0	51.32	177.48	22.57	51.01	170.82	23.57	42.90	602.23	.00*	.00*	.00*	.00*
8: 0: 0	53.34	194.15	28.58	54.05	187.48	30.55	42.98	840.59	.00*	.00*	.00*	.00*
10: 0: 0	55.37	194.15	30.93	56.08	195.81	32.15	41.26	839.18	.00*	.00*	.00*	.00*
12: 0: 0	59.42	202.48	32.03	61.15	204.15	33.77	42.72	843.40	.00*	.00*	.00*	.00*
14: 0: 0	61.45	194.15	28.30	62.16	195.81	30.42	42.86	841.29	.00*	.00*	.00*	.00*
16: 0: 0	64.49	203.31	28.97	65.20	203.31	29.57	44.26	838.48	.00*	.00*	.00*	.00*
18: 0: 0	62.46	194.98	27.93	63.17	194.98	30.35	42.98	838.48	.00*	.00*	.00*	.00*
20: 0: 0	59.42	194.98	28.40	60.13	194.98	30.25	42.96	840.23	.00*	.00*	.00*	.00*
22: 0: 0	56.38	194.98	27.98	58.11	194.98	29.93	42.86	838.83	.00*	.00*	.00*	.00*
08/11/90												
0: 0: 0	54.36	194.98	28.82	55.07	194.98	29.65	42.98	841.29	.00*	.00*	.00*	.00*
2: 0: 0	54.36	194.98	27.28	55.07	194.98	30.10	42.96	760.43	.00*	.00*	.00*	.00*
4: 0: 0	52.33	194.98	27.78	54.05	194.98	29.35	42.98	784.34	.00*	.00*	.00*	.00*
6: 0: 0	50.30	194.98	26.95	52.03	194.98	29.52	43.20	767.11	.00*	.00*	.00*	.00*
8: 0: 0	50.30	194.98	28.53	51.01	186.65	30.48	42.90	815.98	.00*	.00*	.00*	.00*
10: 0: 0	53.34	194.98	28.35	54.05	186.65	31.05	42.92	839.88	.00*	.00*	.00*	.00*
12: 0: 0	57.40	194.98	28.18	58.11	194.98	30.08	42.90	838.48	.00*	.00*	.00*	.00*
14: 0: 0	60.44	194.98	28.22	61.15	194.98	30.45	42.96	839.18	.00*	.00*	.00*	.00*
16: 0: 0	61.45	193.31	28.13	63.17	196.65	31.48	42.96	838.12	.00*	.00*	.00*	.00*
18: 0: 0	59.42	193.31	27.85	60.13	196.65	32.58	42.80	840.23	.00*	.00*	.00*	.00*

14112 G.B.


MASTER
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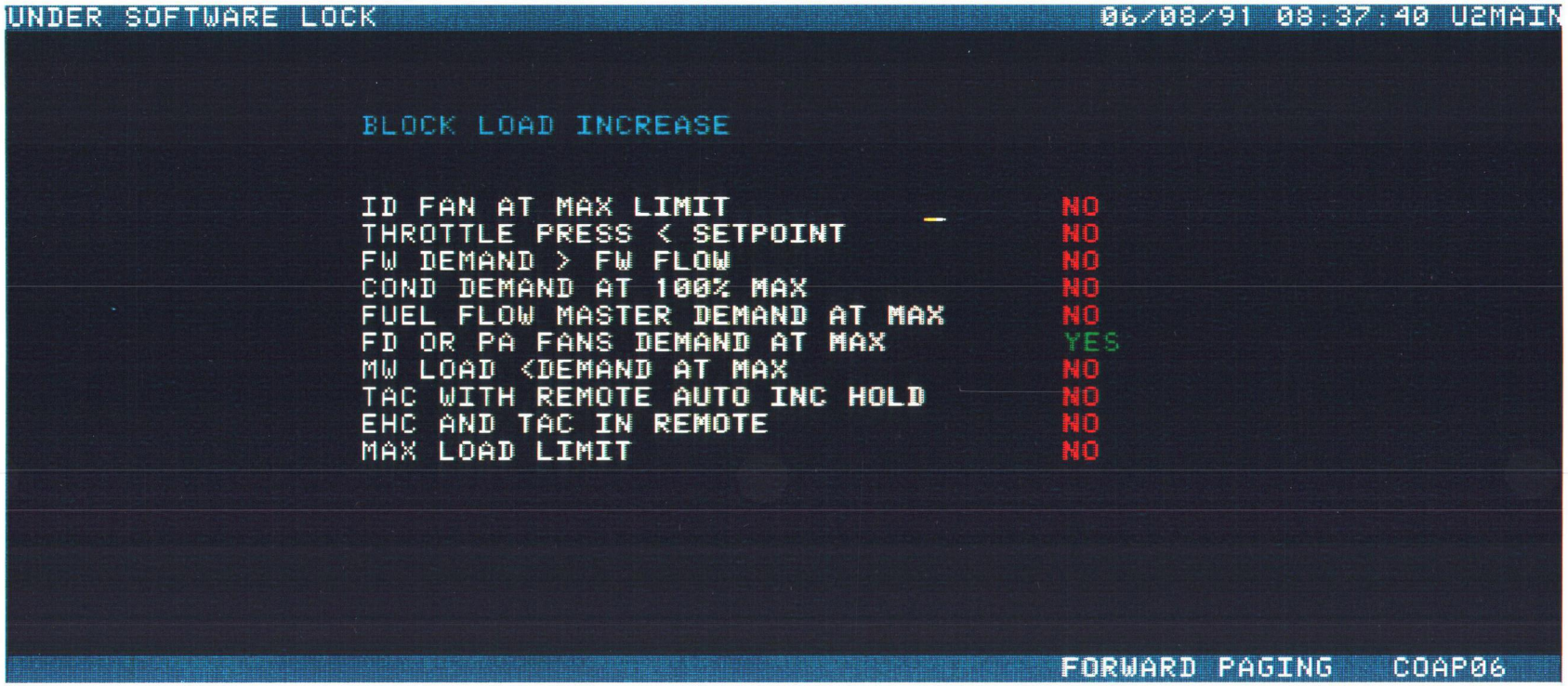
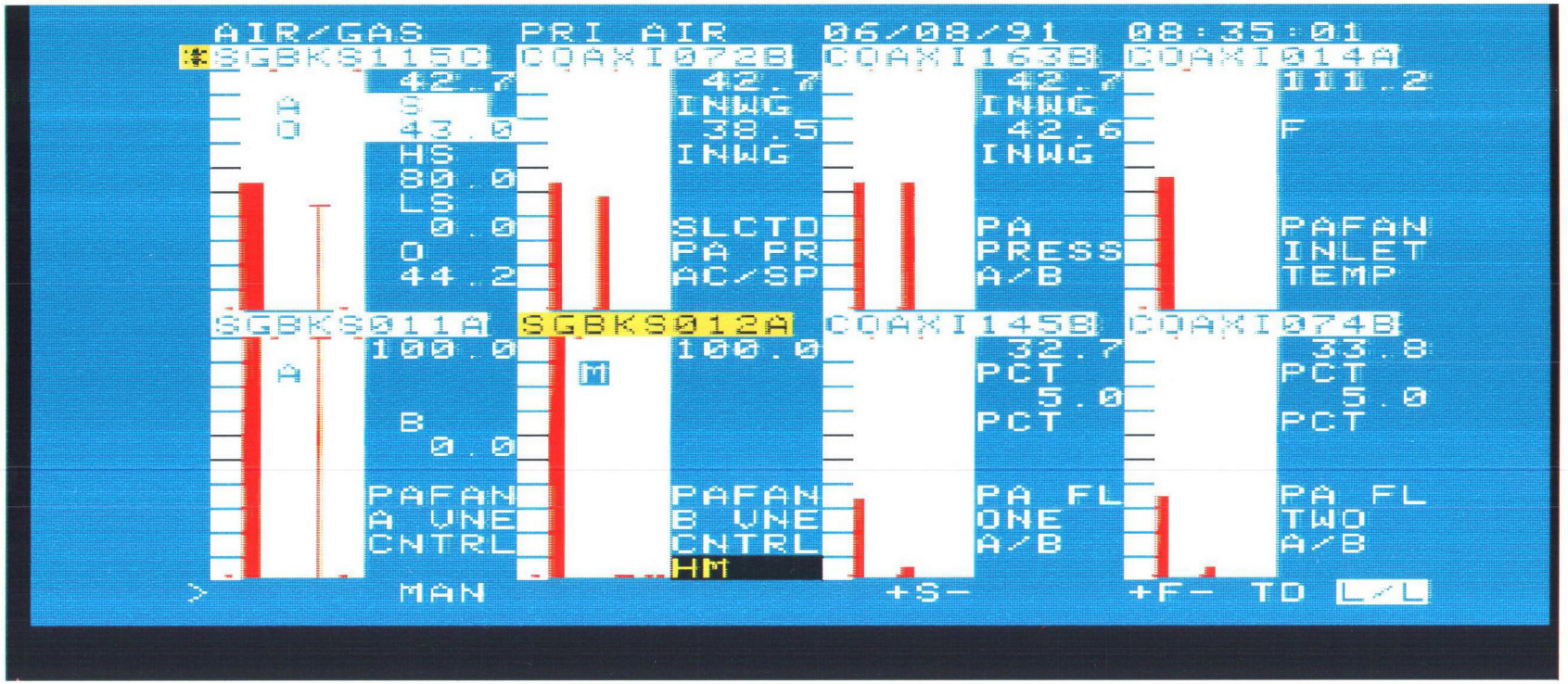
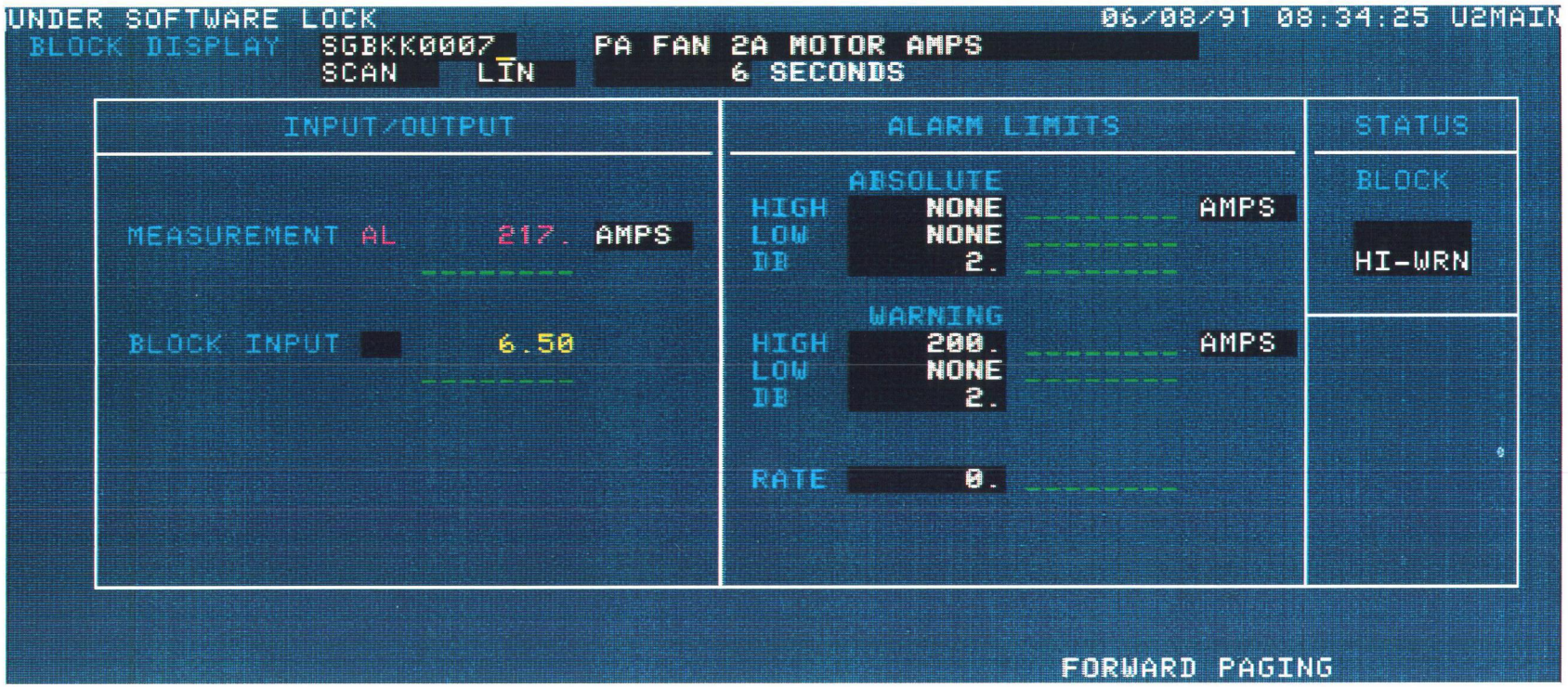
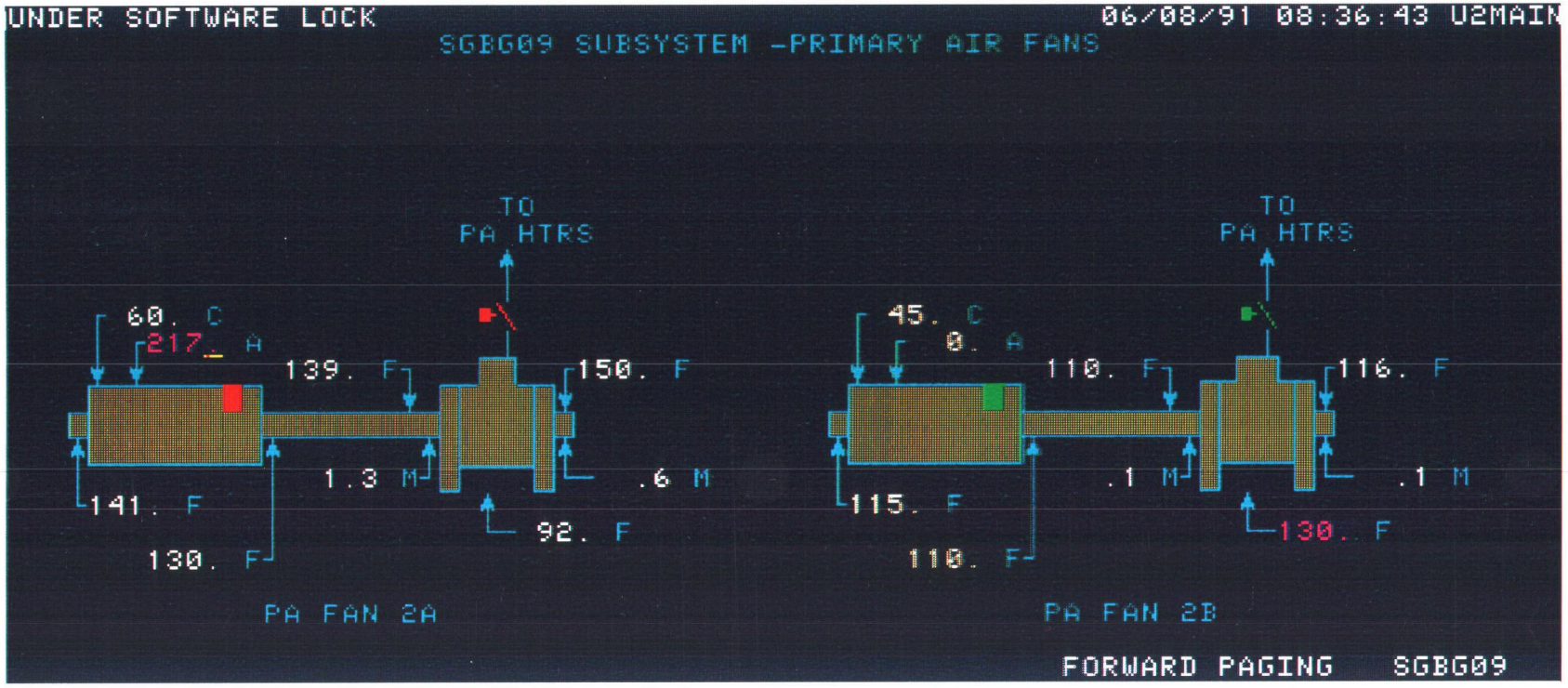
COAKS125A
COAXI127A
COAXI130A
AGC
AGC/
LOCAL
SELCT
MW
0
303.
AGC
MW
UNIT
STATS
DSPLY
BLI
UNIT
STATS
ALRMS
COAKS142A
NO
HOLD
LOAD
SELCT
COAXI168B
300.
MW
350.
MW
LOAD
LIMIT
DSPLY
COAXI167A
5.
MW/M
RATE
LIMIT
DSPLY
+S-
+F-
L/L


UNDER SOFTWARE LOCK
06/08/91 08:37:40 U2MAIN
BLOCK LOAD INCREASE
ID FAN AT MAX LIMIT NO
THROTTLE PRESS < SETPOINT NO
FW DEMAND > FW FLOW NO
COND DEMAND AT 100% MAX NO
FUEL FLOW MASTER DEMAND AT MAX NO
FD OR PA FANS DEMAND AT MAX YES
MW LOAD <DEMAND AT MAX NO
TAC WITH REMOTE AUTO INC HOLD NO
EHC AND TAC IN REMOTE NO
MAX LOAD LIMIT NO
FORWARD PAGING COAP06


AIR/GAS
PRI AIR
06/08/91
08:35:01
SGBKS1150
COAXI072B
COAXI163B
COAXI014A
42.7
INWG
38.5
INWG
42.6
INWG
111.2
F
HS
80.0
LS
0.0
44.2
SLCTD
PA PR
AC/SP
PA
PRESS
A/B
PAFAN
INLET
TEMP
SGBKS011A
SGBKS012A
COAXI145B
COAXI074B
100.0
100.0
32.7
PCT
5.0
PCT
33.8
PCT
5.0
PCT
PAFAN
A VNE
CNTRL
PAFAN
B VNE
CNTRL
HM
PA FL
ONE
A/B
PA FL
TWO
A/B
MAN
+S-
+F-
TD
L/L


UNDER SOFTWARE LOCK
06/08/91 08:34:25 U2MAIN
BLOCK DISPLAY SGBKK0007
PA FAN 2A MOTOR AMPS
SCAN LIN
6 SECONDS
INPUT/OUTPUT
MEASUREMENT AL 217. AMPS
BLOCK INPUT 6.50
ALARM LIMITS
ABSOLUTE
HIGH NONE AMPS
LOW NONE
DB 2.
WARNING
HIGH 200. AMPS
LOW NONE
DB 2.
RATE 0.
STATUS
BLOCK
HI-WRN
FORWARD PAGING


UNDER SOFTWARE LOCK
06/08/91 08:36:43 U2MAIN
SGBG09 SUBSYSTEM -PRIMARY AIR FANS
TO
PA HTRS
60. C
217. A
139. F
150. F
141. F
1.3 M
.6 M
130. F
92. F
PA FAN 2A
TO
PA HTRS
45. C
0. A
110. F
116. F
115. F
.1 M
.1 M
110. F
130. F
PA FAN 2B
FORWARD PAGING
SGBG09